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M.DCCC.XXX.
DIVINATION is often confounded with omen. The two words, however, have peculiar and distinct meanings. An omen is an indication of what is to come to pass, which happens without the person seeking it, or at least being instrumental in producing it; whereas divination is obtaining the knowledge of futurity by some endeavour of our own. It is evident, however, even after this distinction is made, that it will be difficult to determine under which division many supposed indications of future events, to which superstitious people give credence, ought to be placed. The superstitious inferences that are drawn from certain animals crossing the path, and from the flight of birds, &c. are certainly, by this definition, to be considered as omens; but it is not easy to determine whether the superstitious inferences, which were drawn by the ancients from the appearance of the entrails, &c. of their sacrifices, should be classed under the head of divination or omens.

It is not our intention in the present article, to enumerate all the species of divination which have been and are practised by superstitious people; but only to notice those kinds or instances, which are less familiar to general readers, or which are particularly curious.

The Jews had many kinds of divination, most of which are described or mentioned in the Old Testament, or by the Rabbinical commentators on it. Some of these, however, seem to belong rather to the class of omens, than to that of divination. The first kind was performed, by consulting the stars, clouds, signs, tokens, and the like; and is designated in the Old Testament by the word monachēsk. This, though reckoned a species of divination by the Talmud, is evidently a species of omen. The second kind was by a divining cup, which is particularly mentioned in the 44th chapter of Genesis, verses 5 and 15. The third mode was by consulting familiar spirits; and it is singular, that the Hebrew word for this species, is very similar to the word which the Negroes apply to their Oboe man in the West Indies. The 4th species of Jewish divination was by interfering the dead. The 5th seems to have consisted in a species of legerdemain. The 6th is expressed by a word, which signifies a matterer. Besides these, divination was practised by teraphins, by the flight of arrows, by the liver of beasts, by sticks and staves, &c.

The practice of divining by the raphins, or images, by the entrails of beasts, and by arrows, the Jews borrowed from the Egyptians. The last mode, that of divining by arrows, was also very common among the Arabsians, who continued to practise it till Mohammedism prevailed, which, in several parts of the Koran, absolutely forbids it. The arrows used for this purpose were without heads or feathers, and were kept in the temple of some idol, in whose presence they were consulted.

The divination, in general, was made by three only: on one of which was written, "My Lord hath commanded me;" on another, "My Lord hath forbidden me;" and the third was blank. If the first was drawn, it was considered as approbation of the enterprise they were about to undertake; if the second, as disapprobation; and if the third, they drew them over again, till either the first or second was drawn. This practice was also used by the ancient Greeks. The other modes of divining used by the Greeks and Romans, we shall pass over, as familiar to most of our readers. The ancient Germans, besides the mode common to most nations, that of divining by the entrails of beasts, had some so peculiar as to deserve notice, especially as they seem to confirm the hypothesis of the Persian origin, or affinity of the Goths; for, like the Persians, their most favoured species of divination was drawn from the horse. Tacitus informs us, that by the neighing of a white horse, which had never been subject to the yoke, they foretold the success of the enterprises they were about to undertake. Another mode of divining by this animal was used by the Vandals. When they were about to commence hostilities, they fixed three rows of spears upright in the ground, and across each row they placed another spear; a horse was then brought out by the priest, and led up to these rows, and if he touched either of them first with his right foot, the omen was propitious, but if with his left it was adverse.

The kinds of divination, to which superstition in modern times has given belief, are not less numerous, or less ridiculous, than those which were practised in the days of profound ignorance. The divining rod, which is mentioned in scripture, is still in some repute.
DIVINATION.

in the north of England, though its application is now confined principally to the discovery of veins of lead ore, seams of coal, or springs. In order that it may possess the full virtue for this purpose, it should be made of hazel. Divination by Virgilian, Horacian, or Bible lots, was formerly very common; and the last kind is still practised. The works are opened by chance, and the words noticed which are covered by the thumb; if they can be interpreted in any respect relating to the person, they are reckoned prophetic. Charles I. used this kind of divination to ascertain his fate. The ancient Christians were so much addicted to the sorte saecularum, or divining by the Bible, that it was expressely forbidden by a council. Divination by the speal, or blade bone of a sheep, is used in Scotland. In the Highlands it is called sleina-reached, or reading the speal bone. It was very common in England in the time of Drayton, particularly among the colony of Flemings settled in Pembrokehire. Camden relates of the Irish, that they looked through the bare blade bone of a sheep, and if they saw any spot in it darker than ordinary, they believed that somebody would be buried out of the house. The Persians used this mode of divination. Another kind was by a plant called bachelors buttons. They were carried in the pockets by the men, and under their apron by the women, and if they continued fresh, good luck in courtship was portended; but if they soon faded, the reverse. Palmistry was one species of divination, which seems to have been studied in a very regular manner. The lines of the hand were distinguished into formal lines; table lines; the line of fortune; the line of life or the heart; the line of the liver, &c. Names were also given to the fingers. The little finger was called the ear finger, because it was used by our ancestors to clean their ears. Divination by the finger nails was another species; though this, as well as some of the others we have noticed, do not properly come under the head of divination. From the spots on the nails, it was supposed not only that the temper might be known, but future events foretold. The divination by sieve and shears, is mentioned by Butler as common in his time. (Hudibras, part ii. can. to 3, line 569.) This kind is also mentioned by Theocritus. It was used to discover thieves. The points of the shears were stuck in the wood of the sieve, which was balanced on the fingers of two persons. Some words out of the 50th Psalm were then read, and the name of the suspected thief pronounced. If the sieve turned suddenly round, he was the guilty person. A Bible and key was used for the same purpose, and in the same manner. Divination by onions and faggots is a German custom, though it seems also to have prevailed in England in the middle of the 17th century. Onions, with the names the fancy applied to them, were put by girls near the chimney, and the first that sprouted bore the name of the destined husband. If after this they wished to know his disposition, they went to the wood-stack and drew a faggot; if it were strait, and without knots, his disposition would be gentle. Divination by a green ivy leaf, which was laid in water on New Year's Eve. It was not to be examined till twelfth night. If it were spotted, the person for whom it was laid will be sick next year. If the spots were near the top, the sickness will be in the head; if in the middle, in the heart; if all over, it portends death. Divination by flowers, was practised in Sicily in the time of Theocritus; and Kerwick mentions divination by the daffodil, as common in England in his time. If it hung its head towards a person, his health would decline. The divinations respecting pulling the bride-cake through the wedding ring, and those practised at Hallow e'en, as described by Burns, are well known.

In Wales, men and girls seek an even leafed sprig of ash. The first who succeeds calls out cynivor, which is answered by the first of the other sex that succeeds; and these are to be married. In what is termed a scalding of peas, a bean is put into one of the pease; whoever gets this is to be married first. Apple perings fung over the head; form the first letter of the name of a person's sweetheart. But one of the most singular species of divination used for this purpose was the following: Girls stuck an apple kernel on each cheek, and to each kernel they gave the name of one of their sweethearts; that which fell first, indicated that the person whose name it bore, was not sincere in his love. On the subject of love and courtship, indeed, various kinds of divination were practised besides those already described, with one or two of which we shall conclude this article. Snails were set to crawl on the hearth, and they were supposed to mark in the ashes the initials of the person beloved. This was principally used on May day. On Valentine's day, there were different kinds of divination. The night before, five bay leaves were to be put under the pillow, and if the sweetheart were dreamt of, the marriage was to take place that year; or an egg was to be boiled hard, the yolk taken out; put into salt, and eat along with the shell, at bed time, without speaking or drinking after it, the dream would in this case point out the sweetheart. By others, the names of their lovers were written on bits of paper, which were rolled up in clay, and put into water; the first that rose was to be the valentine. Brand's Popular Antiquities, vol. ii. 4to, will supply the curious on this subject with many other particulars. (w.s.)

DIVING,

The act of descending to a considerable depth beneath the surface of water, and continuing in that situation a sufficient time, to collect valuable articles from the bottom of rivers, or the sea; such as pearls, sponges, coral, and other submarine productions; or to recover goods lost by shipwreck.

Man does not appear to have been intended by nature for diving, or at least for continuing any time under water; regular respiration being so necessary to his life, that, by the greatest inspiration, he cannot carry down a larger quantity of air than will supply him for two minutes. This we learn from Dr Halley is possible, as he observed in a Florida Indian diver at Bermudas; but it is certainly an extreme case, for ordinary persons generally begin to feel a danger of suffocation in the space of half a minute after submersion in water. The Doctor relates, that those who dive in the Archipelago for sponges, have a practice of taking in their mouths a piece of sponge dipped in oil, with a view, he supposes, of inhaling the air which the sponge contains; and from this they are enabled to dive a longer time than others who employ no artifice. It is not easy to conceive how this can assist the diver's breathing; for the introduction of any foreign substance into the mouth
must necessarily diminish the quantity of air he can take down: But we have been lately informed, that the real object of taking oil in their mouth is to calm those small waves on the surface of the sea, which prevent the light being so steadily transmitted to the bottom, as is necessary to enable the divers to find the small objects they search for without delay. By ejecting a little oil from their mouths, it rises to the surface, and spreading upon it, calms the waves in a most remarkable manner, and gives a brilliant light at the bottom. This singular property of oil has been long known, and is practised in many other ways to allay the agitation of the sea, by fishermen and mariners. A diver has to go through a very great exertion in holding his breath when deep under water; for it should be observed, that an equally great difficulty with the want of air arises in diving at considerable depths, from the pressure of the water upon the surface of the body, tending to compress every cavity within it. It requires a very great muscular strength in the diver to resist this action; no breast-plate or other contrivance can defend him, unless it is made to exclude perfectly the water from his breast, and of sufficient strength to bear the pressure; in which case it would become too heavy and cumbersome to permit his speedy descent and return. To dive at all requires long practice, and habitual exposure to the weight of the water, after the habit of retaining the breath is sufficiently acquired; and it is observed, that when the most expert divers continue to dive repeatedly for any length of time in deep water, their eyes become bloodshot, and a spitting of blood, induced from the great exertion. People who are accustomed to the water from their infancy, will at length be enabled not only to remain much longer under water than could be supposed, but acquire a kind of amphibious nature, so that they seem to have the use of all their faculties, as well when their bodies are immersed in water, as when they are on dry land. Many savage nations are remarkable for this, and, according to the accounts of our late voyagers, the inhabitants of the South Seas islands are such expert divers, that when a nail or any piece of iron was thrown overboard, they would instantly jump into the sea after it, and never fail to recover it, notwithstanding the quick descent of the metal. Even among civilized nations, many persons have been found capable of continuing an incredible length of time under water.

The most remarkable instance of this kind is the famous Sicilian diver Nicola Pesci, who, according to the marvellous account given by Kircher, had from his infancy been so used to the sea, that at last it became his most natural element. It is said he was frequently known to spend five days in the midst of the waves, without any other provisions than the fish which he caught there, and eat raw. He often swam over from Sicily into Calabria, which is a tempestuous and dangerous passage, carrying letters from the king, and as frequently swam among the gulls of the Lipari Islands, without any apprehension of danger. "In aid," says Kircher, "of these powers of enduring the deep, nature seemed to have assisted him, in a very extraordinary manner; for the spaces between his fingers and toes were webbed as in a goose, and his chest became so very capacious, that he could take in at one inspiration, as much breath as would serve him a whole day." A length, however, we are told, this extraordinary person met his fate, in exploring the depths of the whirlpool of Charybdis, at the instance of the king, who, after he had once succeeded in fetching up a golden cup that had been thrown in, ordered him to repeat the experiment. The authenticity of this account depends wholly upon the authority of Father Kircher, who assures us he had it from the archives of Sicily, and that the Sicilian king above mentioned was King Frederic. But, notwithstanding this assertion, the whole is so marvelous, as to prevent us from giving any particulars of the wonders which his hero saw at the bottom of the celebrated Charybdis.

From the many important purposes to which the art of diving is applicable, and from that very general spirit of enterprise which induces ingenious men to attempt what is exceedingly difficult, or apparently impossible, the mechanical projectors of the last two centuries have been stimulated to produce a multitude of inventions for enabling divers to descend to great depths, and to continue under water at pleasure. Of all these, what is called the diving bell has been found the most useful, no other contrivance having been brought to such a degree of perfection in all its parts, as to come in competition with it, for descending in deep water; though some have been found very useful, in particular situations, where the water is of so great depth. We have given descriptions of the different diving bells in a separate article, and shall here briefly notice other inventions for diving, which have come to our knowledge.

The early contrivances are most of them suits of armour, made water-tight by leather, and provided with large head pieces or helmets, to which flexible tubes are attached, for conveying down fresh air, and returning that which has become unfit for respiration; the fresh air being forced down one pipe by bellows, or other means, and allowed to return by another. These pipes supplied the diver with air, whilst the armour, by keeping off the pressure of water from his breast, allowed his chest to dilate upon inspiration. A number of different contrivances of this class are to be found detailed in Leopold's Theatrum Machinarum Hydraulicae, though none of them have been found of extensive use, except in small depths, such as twelve or fifteen feet. At much greater depths this method is not practicable, because it is necessary that the diver should have his limbs exposed, or only covered with a flexible covering, in order to enable him to do any good at the bottom of the sea; and the pressure on the limbs is then so great, as to obstruct the circulation of blood, in the same manner as ligatures would do, whilst those parts of the body which are within the armour being relieved from pressure, the blood is forced from the limbs into them, and causes intolerable pain and distress. It is also difficult to construct an armour sufficiently strong without being unwieldy, and the least defect will fill the whole with water, and endanger the life of the diver, who may be drowned before he can be drawn up.

In Plate CXXXI. Fig. 1, we have given a representation of one of the best of these contrivances, which may be of very extensive use in small depths. It was proposed by H. Klingsert, and is described in a pamphlet published at Breslau in 1796. The harness or armour is made of strong tinfoile, in the form of a cylinder, which encloses the diver's body and head: it consists of two parts, that he may conveniently put it on; also a jacket, with short sleeves, and a pair of drawers of strong leather, all nominal. The armour. The armour. AA is the upper part of the cylinder, having a glo-
bular top to contain his head. It is fifteen inches in height, and its diameter is adapted to the size of the diver at the hip bone. BB is the lower half of the same diameter, and of such length as to meet the other at the dotted line D. Both are provided with strong iron hoops, on the inside of the tin plate at a b and c; also two other pieces of hoop, which cross each other on the inside over his head, and support the globe top. The leather jacket D, dd, and drawers Ex, ee, are attached to the cylinders by buttons, as the Figures show; and to make the joints water-tight, three hoops of brass, a, b, and c, are fitted over each joint, to bind the leather forcibly upon the parts where the cylinders are strengthened by the internal hoops before mentioned. To prevent the leather slipping off, if the buttons should fail, a rim of brass wire is soldered round the circumference of the cylinders, outside, at each joint, and the hoops are put on beyond these. The hoops are made of brass plate; and their ends are turned up and fitted with screws, by which they can be drawn very tight upon the leather. The cylinder AA, BB, has holes cut in it, for the arms to go through; and the upper and lower halves separating at D through these holes, overlap each other a small quantity, by the lower one entering the upper one. The jacket when fastened on, keeps the two halves together, and makes a tight fitting with the arms, the sleeves being bound round them at d by small screw hoops of the same kind as the large ones. The drawers have also brass garters c, e, to fit the leather close round at the knees. f, f, are two holes in the upper half, into which the eye glasses are screwed; and g is a third aperture, provided with a screw to connect the two breathing pipes h and i with the machine, in such a situation that the mouth-piece of the pipe h may be opposite the diver's lips; k is an opening for the diver to breathe through; when out of water it is closed by the screw cap j, before he descends. The breathing pipes are three-fourths of an inch diameter in the inside, and of a sufficient length to reach the surface of the water: they consist of a strong brass wire, wound into a spiral form, and covered with stout leather. To save expense, six yards of the pipe from the mouth may be made in this manner, and the remainder of tin plate tubes, in lengths, united by short leather pipes, to form flexible joints. The pipe h is to supply fresh air, and it is this which joins to the mouth piece within the machine; the other pipe opens into the cavity of the machine. The diver therefore draws his breath through the mouth piece, from the pipe h; but, on expiring, throws the air through his nostrils into the cavity of the machine, from which it escapes by the pipe i to the open air. By this means the air within the machine always remains at the same state of elasticity, and every time he inhales air from the mouth piece, the dilation of his breast forces an equal volume of air from the cavity of the machine, through the pipe i. It is only by this arrangement of the pipes that a man can breathe at all when enclosed in so small a space; for though the harness will defend his breast from the pressure of the surrounding water, it will not be possible for him to breathe and return the air through a single pipe, as some inventors have proposed, through his body must always distend a space equal to the volume of air he inhales; and as the machine does not contain much more than a cubic foot of air, it would make too great a resistance to compression for him to obtain a sufficient supply to support life. A simple experiment will evince the truth of this: Let any one take a cask of one or two cubic feet, and placing his mouth to the aperture, endeavour to return into it the air he has inhaled, it will be found to require an exertion too great to be continued. By allowing a larger space round the diver, the difficulty would be diminished, but would render the apparatus inconvenient. Another insuperable objection to breathing through a single pipe is, that the content of the pipe, unless extremely short and of small bore, will bear a great proportion to the quantity of air the diver inhales at each inspiration; consequently he will, at each time, be obliged to take back as much of the air he had before breathed, as will fill the whole pipe, and only obtain as much fresh air as the difference between the quantity he inhales and the content of the pipe. Nor is it practicable, as others have proposed, for him to breathe through one pipe, and then throw the air out into the water through a mouth piece, which, of course must have a valve, to prevent the water entering the machine. In this case it would require him to condense forcibly the air contained in his lungs, until its expansive force equalled the pressure of the surrounding water, and opened the valve, which is clearly impracticable at a very small depth; for admitting that, by the muscular exertion of the checks, he was able to condense the air sufficiently, still he could not expel the whole of the air from the cavity of his mouth; and this quantity when reduced to its expanded state, would mix with the fresh air, and form a considerable portion as to contaminate it. The construction of the mouth piece of Klingert's mouth machine, which is screwed in at the aperture g, is fully explained by the section, Fig. 2. Here h and i are the ends of the flexible tubes, screwed into a box v, v, which has a male screw t, to fit into the aperture g, Fig. 1. The box has a partition which keeps the two passages separate, the upper one communicating from the pipe h to the ivory mouth piece x, and the other opening at z into the machine, connects it with the pipe i. The leather drawers have a framing of iron within them to resist the pressure. This frame, which is shown separate in Fig. 3, consists of a semicircular piece of iron hoop, v m, also shewn by the dotted lines m m, Fig. 1, extending between the diver's legs, and fastened to the lower extremity c c of the cylinder, at the front and back; also two irons n n, outside the thighs, which are jointed to the cylinder at the points c, c, Fig. 1, and extend down to c, where they are firmly attached to a hoop surrounding the thigh. There is another hoop for each thigh higher up, at the point r. These hoops are farther connected by irons at p p, which, at the upper ends, are fitted to slide upon the semicircular hoop, as shewn at s, Fig. 3. By this means, though the frame is abundantly strong, the diver is at liberty to walk; the joints at c, c, and the traversing of the irons p, upon the hoop m, admitting the motion of his thighs, because the centres of motion correspond with the hip joints. The leather drawers are fitted over the framing, and sewed to the hoops; but if the depth is to be considerable, the inventor advises a net of small chains to be stretched over the frame, in different directions, before the leather is put on. As it is not possible to sew the leather so completely as to prevent wholly the water from leaking in at the seams, in all probability a pump is fixed at l, in front of the machine, to extract the water when it has accumulated, so as to rise a few inches in the cylinder. To prevent leakage as much as possible, the jacket and drawers must be very carefully made with slips of leather sewed very closely over the seams. The pipes must be made of the very best leather, which will be rendered very close in its pores, and prevented from becoming hard, by dressing it with a composition of the leather.
Diving.

PLATE CCXXXI.

Fig. 1.

Klingert's machine, to enter into a detailed description of any other of the same class, such as Kessler's water armour, which he proposed in 1617, and many others, as the one which we have described seems to contain all that is good in the others. Some of them have an essential difference in the apparatus for breathing, viz. by forcing down the air by bellows or a pump, and thus condensing it into the machine, until its elastic pressure is sufficient to repel the pressure of the water. The soul air which has been breathed, may, in this case, be suffered to escape from the machine through a valve into the water, or it may be conducted to the surface by a pipe. Of this kind is the apparatus contrived by Mr Tonkin, and employed for some time in raising parts of the wreck of the Abergavenny East India ship, which was unfortunately lost off Weymouth in 1804. It consisted of a body of copper with iron boots, put together and jointed in the manner of coats of mail; the whole is then covered with leather, and afterwards with canvas, painted white to distinguish it under water. The arms are made of strong water proof leather; and the place for sight is about 8 inches diameter, glazed over with a plate of glass an inch thick. The diver is sunk in this machine by means of weights, fastened equatorially round the waist of it; and he is suspended by a rope, by means of which his situation is changed at pleasure. A flexible air tube communicates with an air vessel in the boat above. Through this tube the diver gives his instructions, and obtains his supply of fresh air. This machine was used with very good effect in a depth of near 7 fathoms water, and enabled the diver to direct the operation of several curious machines, such as saws for clearing away the ship's decks, and making sufficient openings to give him access to the treasure below, as well as tongs, &c. for taking up the heavy goods by tackle in the vessel above.

The next class of diving machines which we shall describe, are those in which the diver is shut up, with a sufficient quantity of air to supply him a considerable time; and in this he descends, proper contrivances being provided, to enable him to work at the bottom, where he can only continue as long as his supply of air is sufficiently pure for respiration, which will be but a short time, unless the machine is enormously large; for a man will, according to an experiment of Dr Halley's, consume a gallon of air in the course of a minute, and as he throws out the impure air to mix with the rest, it will so contaminate it, that by the time he has breathed one half the air, the whole will become very unfit for respiration, and oblige him to be drawn up to recruit it. We understand, that in a vessel containing a ton, a single man may remain an hour without injury.

The diving bladder contrived by Borelli, is the earliest of this kind. It is described in his Opera Posthuma, to consist of a vessel of copper, which he calls the vesica, or bladder, and is about two feet diameter. This is to contain the diver's head, and is to be fixed to a great skin habit, exactly fitting to the shape of his body. The person carries an air pump by his side, by means of which he may condense or rarify the air in the vesel, and thus make himself heavier or lighter on the same principle as fishes do, by contracting and dilating their air bladder. Within this vesica there are pipes, by means of which a circulation of air is contrived; and, by this arrangement, Borelli supposed the objections to which all other diving machines were liable would be obviated, particularly that of their air; "the moisture by which it is clogged in respiration, and by which
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[80x393] leather, [97x16] machine

of himse lf to made the great machine, to the

[88x217] one, or

of the machine, the air is drawn out of the water, the pipes unscrewed, and by blowing fresh air with a pair of bellows at one aperture, the foul air is driven out at the other, and the machine prepared for another descent.

The diver has the power of ascending or descending with the machine at pleasure, without being dependent upon those in the boat, by means similar to the air bladder of fishes. Thus the ballast is so adapted to the size of the machine, as to make it sink so far that only a cubic foot of it remains above water. In this state, an additional weight of 100 pounds will depress it below the surface, or make it sink to the bottom. The effect of adding extra weights is produced, by diminishing the volume of contained air, by condensing it into a smaller space. To accomplish this, a large cylinder is applied in the bottom of the vessel, and provided with a piston, which, by a rack and pinion, can be moved from one end of the cylinder to the other, when the diver turns a handle, coming through the side of the machine, and communicating motion by a worm and wheel to the pinion of the rack before mentioned. The lower end of the cylinder is open to the water, and the upper end opens within the machine; therefore, when the diver turns the handle in the direction to raise up the piston in its cylinder, it necessarily diminishes the bulk of the included air, and the machine will sink; but on depressing the piston in the cylinder, it will ascend again. The inventor proposed to furnish the machine with two small oars to move it in the water, and an anchor or grapnel to make it fast, whilst the diver walks about on the bottom, within the limits of the length of the pipe, to examine sunk bodies, and discover the best mode of raising them. To prevent danger from any accident happening to the machine, the diver is to be provided with the means of quickly detaching the pipes from the machine, and retaining a sufficiency of air in the armour to carry him to the surface, when he throws off the weights suspended from his girdle.

Mr Klingert also mentions a lantern of his invention which may be very useful to a diver at the bottom of the sea. The principles of its construction he keeps secret, but asserts that it is very simple, and that a candle inclosed in one of them will burn in every kind of air in mines and pits, where all other lights are extinguished. It contains a space equal to a cubic foot, and the candle will burn without any addition of fresh air from without for 2 or 3 hours.

Plate CCXXXI. Fig. 4, represents a diving machine invented in 1753 by Mr Rowe. It is a trunk or hollow copper vessel aa BD, soldered or rivetted together with strength proportioned to the depth of water where it is to be fixed. It contains the diver’s body, and also a sufficiency of air for the time he intends to dive. He enters with his feet first at the open end aa, which is then closed by a lid or cover screwed on, by a number of screw bolts passing through the flanges a, a. The vessel is bent at D, for the bearing of the diver’s knees, and has sufficiency of leaden ballast at G, to sink it in the right position. bb are two hoops surrounding it, which, at the same time that they strengthen it, afford points of suspension by a bar d, which is attached to them, and is pierced with several holes to admit a span upon
the rope E, which is so adjusted, as to suspend the whole, with the diver in it, nearly in the position of the Figure, when he will be in a convenient posture for working with his arms, which come through openings k in the vessel, to which sleeves e, of very strong leather, are attached by a hoop or ring, screwed to the vessel with the leather between them. The sleeves are lined with cloth, and the edges round the holes k are defended by soft quilting, from hurting the diver's arms by the pressure, as well as to prevent the sleeves and his arms being thrust inwards. i is an aperture covered by a strong lens, for the diver to see through. At m and n are two other openings in the upper part of the vessel, covered by screw caps, which are removed when fresh air is to be introduced into the machine by the nose pipe of a pair of bellows, being applied to force fresh air into one, and drive out the foul air at the other. The lower opening at n is also of use, to pump out any water which may leak through at the joints, though this is as much as possible prevented, by fitting leather, at m in the joints of the cover, and the caps m, n before they are screwed tight. The mass of lead G is fastened to the lower side of the vessel in a line between the diver's arms, by means of the hoops b, B. On this the whole rests if it comes to the ground, and remains in a proper position for the diver to work, and fasten ropes to any thing which is to be drawn up, as shewn in Fig. 5.

If the water is very deep, the diver must wear a kind of saddle on his back, which having a ridge touching the top part of the vessel withinside, enables him to keep his arms properly out of the apertures, otherwise he would not have strength to resist the pressure acting upon the surface of the arms and sleeves, which forces them into it with a weight proportional to the quantity of surface exposed, end to the depth of water. The diver gives his instruction to those above by a small line r, which is laid through a staple at the side of the machine, and has a handle always hanging in reach of the diver's hand. The upper part of this line is held by a person in the boat or ship above, to whom any signal is given, by the diver snatching or twitching the line a certain number of times, as has before been agreed upon. This is immediately felt by the person above, who give orders accordingly. The size of the vessel is such, that he can continue at the bottom about half an hour, without any pipes or other supply, and will be enabled to do many things very readily; such as recovering moorings, chains lost in rivers or harbours, hooking ropes for weighing up lost anchors, or any other purpose where there is free access to the objects sought, though in entering and searching the wrecks of ships, it would be less convenient than some others which we shall describe. To dive in still water with this machine, requires no other rope than that marked E, which suspends its weight from the yard arm of a ship, and the signal line r to communicate orders to those above. If it is required to dive in a rapid current, a difficulty will arise from the water carrying the vessel out of its direction. In this case, the method shewn in Fig. 5. will be very effectual. It represents a vessel lying at anchor by the cable or hawser a, so as to be up-stream of the spot to which the diver is to descend; then by veering away, or taking up the hawser, she can be brought over the place at pleasure. At the end of the vessel's gaff, a middle block l. is lashed, and a small hawser f f f y rope through it. One end of this has a stream anchor, or a grapnel N, bent to it, with a considerable weight attached to the stock. The other end of the hawser is conducted to the windlass at R, through a leading snatch block fixed on the deck at k. By this means it may be taken in, or given out, as the tide rises or falls; and, by the position of the gaff, the hawser stands clear over the vessel's side, to guide the diving vessel B, when it is let down or taken up, in the following manner: A traveller, or iron ring t, is put upon the hawser f, to run freely up and down upon it, by means of two ropes s and n. The rope s passes through a small block q at the gaff, and goes down to the deck, the lower end being fastened to the traveller. The other rope n passes through a block p, lashed to the shank of the grapnel. The ends of this are conducted through another sheave of the block q, and also brought on the vessel's deck where both are, and belayed on the gunnel. Now by hauling the rope s, and letting go the other n, the traveller is drawn up on the hawser, and vice versa. The traveller i carries a block x for the rope v, which is attached to the engine B at one end, and goes up to the block M at the end of the gaff. It is then taken down on deck through the block q, and held by a sufficient number of hands to guide the engine. E is another rope suspending the weight of the engine from the vessel's quarter, and is held by several men, r being the signal line, as before mentioned.

A vessel moored in this manner by the head in a rapid stream, will steer by the rudder to turn her side-wise within small limits; but in this motion she turns upon a centre of motion very nearly coincident with the hawser f, so as not to disturb the grapnel N. The diver being put into the vessel, and the joints screwed up tight, the rope v is hauled till the engine comes home to the block x on the traveller, as it lies upon the deck; then by hauling the end of the rope v, the engine is hoisted clear; and by slackening it out, and at the same time hauling n, the traveller and engine are taken down perpendicularly to the bottom. The rope E being slacked away by a round turn over a timber head on the vessel's quarter, to lower it gradually when the diver gives the signal of being near the bottom, the rope E is held fast, and r being still given away, the engine is conveyed in the easiest manner to the situation shewn by the Figure, where the object sought is supposed to be. In this condition, he can be moved with great precision to any situation lie directs by the signals. Thus by hauling or giving out the rope v, he will move up stream or down stream; and by the steerage of the vessel's rudder, will be moved athwart the stream to the required situation; but if this is not exactly known before the diver descends, it will be prudent for the vessel to moor with two anchors at a distance asunder, the cables of both meeting on her bow a, with an angle in this situation. By giving out one cable, and taking up the other, she may be made to ride at any part of the stream. A diving machine of this kind may, on many occasions, be useful, and to descend in it occasions no danger to the diver, provided he is suspended by tackle, which will bring him up quick enough when he gives the signal. When he wants fresh air, the vessel, if made of copper, must be either turned or japanned on the inside, otherwise it would give a most nauseous taste to the diver confined within it, which is not less pernicious than offensive.

Fig. 7. represents a very useful tackle or tongs, for taking up articles from the bottom. Every diver should have this provided with several pairs of these of different dimensions. In small depths they will bring up goods Fig. 7. without any person descending; but when they are
Diving.

The dancing, by a diver at the bottom to take up the goods which are wanted, they are extremely expeditious in their operation. A, represents the rope let down into the water. It is attached to the pole or iron shank B, which at the lower end has two arms abc, abc joined by a common piece d, which slides upon B, and has a shackle with the rope D fastened to it. When these tongs are let down by the rope A, the weight of the socket, and links ad, disposes the claws to open as in the figure, and in this state they are lowered or guided by the diver upon the goods to be recovered. The rope D is then drawn up, which raising the shackle, closes the claws upon the object between them, and grips them so hard that they will seldom slip, because the greater the weight the more powerfully they close together. If they fail of catching it the first time, they may be opened again by drawing the rope A, to make another trial.

The experiment of Drebé's submarine boat, is not the only attempt which has been made to navigate a vessel under water, without any communication with those at the surface, but having the means of ascent or descent, and making progress in any direction, independent of assistance from without. The celebrated Bishop Wilkins, in his Mathematical Magic, dated 1648, has given a chapter on the subject, in which, after referring to the successful experiments of Drebé, he enumerates the benefits of these submarine enterprises, and with a visionary facility, which is truly extraordinary, removes all difficulties. Thus for letting out and taking in such things as the nature of the voyages may require, he recommends bags or flexible tubes, somewhat resembling the scupper bags of ships. The progressive motion may, he observes, be produced by fins or oars, which will operate with ease when the vessel is truly equipped; and if swiftness could not thus be obtained, still he supposed the observations and discoveries to be made at the bottom of the sea would abundantly recompense for that defect. The greatest difficulty, in his apprehension, would be in the necessity of renovating the air for respiration and combustion; but for removing this, he advances the probability, that custom may render men capable of living in air of inferior purity; and besides, he has several philosophical views and projects. The convenience and advantages of submarine navigation which he enumerates are, 1st, Privacy, as a man may thus go to any part of the world invisible, without being discovered or prevented. 2d, Safety, from the uncertainly of tides and tempests which vex the surface, from pirates and robbers, and from the ices, which so much endanger other voyages towards the poles. 3d, It may be of use to undermine and blow up a navy of enemies, or to relieve a blockaded place. As the prospect enlarges in the mind of our author, he proceeds to contemplate the inestimable benefits of submarine discoveries; experiments on the ascent and descent of submerged bodies; the exploration of the deep caverns and passages of the waters of the ocean; observations on the nature and kinds of fishes, with the allurements, artificial, and treacherous, which may be successfully practised upon them during so familiar a residence in their territories; the food and oil they may afford; the probability of fresh springs for a supply of water at the bottom of the sea; the facility of recovering submarine treasures, whether lost, or naturally produced beneath the ocean.

The nearest approaches to realizing the bishop's ingenious conoeits, besides the experiment of Debroel, was made by Mr. D. Bushnell of Connecticut, in America, who, in 1787, published a description of a submarine vessel of his invention, in which it was found very practicable to travel under water; though we cannot regret, that he failed in his ultimate view of destroying ships, by approaching them under water, and fixing a magazine to them, which was to explode at the expiration of a certain time, after the diver left it detached from his vessel. The whole invention displays very great ingenuity and originality of idea. It is minutely explained in the publication alluded to; but as it is too complicated to be wholly understood from the verbal description, without greater attention than ordinary readers are disposed to give, our draughtsman has prepared two figures, viz. a vertical section, Plate CXXXII. Fig. 9, and a horizontal section, Fig. 8, from the inventor's description, which, except the letters of reference, is as follows: The external shape of the submarine vessel bore some resemblance to two upper tortoise shells of equal size joined together, the place of entrance into the vessel being represented at A, Fig. 9, by the opening made by the swell of the shells at the head of the animal. The inside was capable of containing the operator, and air sufficient to support him thirty minutes without receiving fresh air. At the bottom B, opposite to the entrance, was fixed a quantity of lead for ballast. At one edge, which was directed before the operator, who sat upright, was an oar D, for rowing forward or backward. At the other edge was a rudder E for steering. An aperture at the bottom, with its valve a, was designed, to admit water for the purpose of descending; and two brass forcing pumps b, b', served to eject the water within when necessary for ascending. At the top, there was likewise an oar F for ascending or descending, or continuing at any particular depth. A water gauge, or barometer d, determined the depth of descent, a compass directed the course, and a ventilator within supplied the vessel with fresh air when on the surface. The internal shape of the vessel in every possible section of it, verged towards an ellipsis as nearly as the design would allow; but every horizontal section, see Fig. 8, although elliptical, yet came as near to a circle as could be admitted. The body of the vessel was made exceedingly strong; and to strengthen it as much as possible, a firm piece of wood H was framed parallel to the conjugate diameter, to prevent the sides from yielding to the great pressure of the incumbent water in a deep immersion. This piece of wood was also a seat for the operator. The entrance at A into the vessel was elliptical, and so small as barely to admit a person. This entrance was surrounded with a broad elliptical iron band ee, the lower edge of which was let into the wood, of which the body of the vessel was made, in such a manner, as to give its utmost support to the body of the vessel against the pressure of the water. Above the upper edge of this iron band, there was a brass crown, or cover G, resembling a hat with its crown and brim, which shut watertight upon the iron band ee. The crown was hung to the iron band with hinges, so as to turn over sidewise when opened. To make it perfectly secure when shut, it might be screwed down upon the band by the operator, or by a person without.

There were in the brass crown three round doors, one at f directly in front, and one at g on each side, large enough to put the hand through. When open, they admitted fresh air. Their shutters were ground perfectly tight into their places with emery, hung with
Diving.

Fig. 8.

The vessel was chiefly ballasted with lead fixed to its bottom B. When this was not sufficient, a quantity was fixed within at R, more or less according to the weight of the operator. Its ballast made it so stiff, that there was no danger of oversetting. The vessel with all its appendages, and the operator, was of sufficient weight to settle it very low in the water. About 200 pounds of the lead B at the bottom for ballast, could be let down forty or fifty feet below the vessel. This enabled the operator to rise instantly to the surface of the water, in case of accident.

When the operator would descend, he placed his foot upon the top of a brass valve a, depressing it by which he opened a large aperture in the bottom of the vessel, through which the water entered at his pleasure. When he had admitted a sufficient quantity, he descended very gradually. If he admitted too much, he ejected as much as was necessary to obtain an equilibrium by the two brass forcing pumps l, j, which were placed at each hand, as shown in Fig. 8. Whenever the vessel leaked, or he would ascend to the surface, he also made use of these forcing pumps. When the skilful operator had obtained an equilibrium, he could row upward or downward, or continue at any particular depth.

With an oar F placed near the top of the vessel, formed upon the principle of the screw, the axis of the oar entering the vessel, by turning the oar one way he raised the vessel, by turning it the other way he depressed it.

A glass tube d, 18 inches long, and 1 inch in diameter, standing upright, its upper end closed, and its lower end, which was open, screwed into a brass pipe, through which the external water had a passage into the glass tube, served as a water gauge or barometer to show the depth of water. There was a piece of cork, with phosphorus on it, put into the water gauge. When the vessel descended, the water rose in the water gauge, condensing the air within, and bearing the cork, with its phosphorus, on its surface. By the light of the phosphorus, the ascent of the water in the gauge was rendered visible, and the depth of the vessel under water ascertained by a graduated line. An oar D, formed upon the principle of the screw, was fixed in the fore part of the vessel. Its axis entered the vessel, and being turned one way rowed the vessel forward, but being turned the other way rowed it backward. It was made to be turned by the hand or foot.

A rudder E, hung to the hinder part of the vessel, commanded it with the greatest ease. The rudder was made very elastic, and might be used for rowing forward. The tiller m was within the vessel at the operator's right hand, and passing behind him, was fixed at a right angle on an iron rod, or spindle n, Fig. 8, which passed through the side of the vessel. The rod had a crank on its outside end, which commanded the rudder by means of a rod o, extending from the end of the crank to a kind of tiller fixed upon the left hand of the rudder. Raising and depressing the first-mentioned tiller m, turned the rudder as the case required.

A compass, marked with phosphorus, directed the course both above and under the water, and a line and lead sounded the depth when necessary.

Every opening was well secured. The pumps b, b had two sets of valves. The aperture a at the bottom for admitting water, was covered with a plate, perforated full of holes to receive the water, and prevent any thing from choking the passage, or stopping the valve from shutting. The brass valve might likewise be forced into its place with a screw if necessary. The air pipes i had a kind of hollow sphere fixed round the top of each, to secure the air pipes' valves from injury. These hollow spheres were perforated full of holes, for the passage of the air through the pipes. Within the air pipes were shutters to secure them, should any accident happen to the pipes, or the valves on their tops. Wherever the external apparatus passed through the body of the vessel, the joints were round, and formed by brass pipes, which were driven into the wood of the vessel; the holes through the pipes were very exactly made, and the iron rods which passed through them were turned in a lathe to fit them; the joints were also kept full of oil, to prevent rust and leaking. Particular attention was given, to bring every part necessary for performing the operations, both within and without the vessel, before the operator, and as conveniently as could be devised, so that every thing might be found in the dark, except the water gauge and the compass, which were visible by the light of the phosphorus; and nothing required the operator to turn to the right hand or to the left to perform any thing necessary.

The inventor then gives the following description of Powder magazine and its appendages, designed to be convey-

made by the submarine vessel to the bottom of a ship.

In the fore part of the brim of the crown G of the submarine vessel was a socket, and an iron tube dotted at h (Fig. 9.) passing through the socket. The tube stood upright, and could slide up and down in the socket six inches. At the top of the tube was a screw dotted at x, properly formed for entering wood, fixed by means of a rod which passed through the tube h, and screwed the wood screw fast upon the top of the tube. By pushing the wood screw up against the bottom of the ship, and turning it at the same time, it would enter the planks. Driving would also answer the same purpose. When the wood screw was firmly fixed, it could be cast off, by unscrewing the rod which fastened it upon the top of the tube.

Behind the submarine vessel, was a place above the rudder E for carrying a large powder magazine. This was made of two pieces of oak timber, large enough, when hollowed out, to contain 150 pounds of powder, with the apparatus used in firing it, and was secured in its place by a screw turned by the operator. A strong piece of rope extended from the magazine to the wood screw above mentioned, and was fastened to both. When the wood screw was fixed, and to be cast off from its tube, the magazine was to be cast off likewise by unscrewing it, leaving it hanging to the wood screw. It was lighter than the water, that it might rise up against the object to which the wood screw and itself were fastened.

Within the magazine was an apparatus, constructed to run any proposed length of time under twelve hours. When it had run out its time, it unpinioned a strong lock resembling a gun lock, which gave fire to the pow-
Diving.

This apparatus was so pinioned, that it could not possibly move till by casting off the magazine from the vessel it was set in motion.

The skilful operator could swim so low on the surface of the water, as to approach very near a ship in the night without fear of being discovered, and might, if he chose, approach the stem or stern above water with very little danger. He could sink very quickly, keep at any depth he pleased, and row a great distance in any direction he desired, without coming to the surface; and when he rose to the surface, he could soon obtain a fresh supply of air, when, if necessary, he might descend again, and pursue his course. The above vessel, magazine, &c. were projected in the year 1771, but not completed until the year 1775.

The ingenious writer then details the following experiments which he made, to prove the nature and use of a submarine vessel for destroying shipping.

The first experiment I made was with about two ounces of gunpowder, which I exploded 4 feet under water, to prove to some of the first personages in Connecticut that powder would take fire under water.

The second experiment was made with two pounds of powder, inclosed in a wooden bottle, and fixed under a hogshead, with a two inch oak plank between the hogshead and the powder. The hogshead was loaded with stones as deep as it could swim. A wooden pipe descending through the lower head of the hogshead, and through the plank into the powder contained in the bottle, was primed with powder. A match then put to the priming exploded the powder, which produced a very great effect, rending the plank into pieces, demolishing the hogshead, and casting the stones, and the ruins of the hogshead, with a body of water, many feet into the air, to the astonishment of the spectators. This experiment was likewise made for the satisfaction of the gentlemen above mentioned.

The inventor afterwards made many experiments of a similar nature, some of them with large quantities of powder. They produced very violent explosions, much more than sufficient for any purpose he had in view.

In the first essays, with the submarine vessel, Mr Bushnell took care to prove its strength to sustain the great pressure of the incumbent water, when sunk deep, before he trusted any person to descend much below the surface, and he never suffered any person to go under water, without having a strong piece of rigging made fast to it, until he found him well acquainted with the operation necessary for his safety. After that he made him descend and continue at particular depths, without rising or sinking, row by the compass, approach a vessel, go under her, and fix the wood screw, mentioned above, and dotted at b, in Fig. 9, into her bottom, &c. until he thought him sufficiently expert to put his design into execution.

He found, agreeable to his expectations, that it required many trials to make a person of common ingenuity a skilful operator. The first he employed was very ingenious, and made himself master of the business; but was taken sick, in the campaign of 1776, at New York, before he had an opportunity to make use of his skill, and never recovered his health sufficiently afterwards.

After various attempts to find an operator to his wish, the inventor sent one who appeared more expert than the rest, from New York, to a fifty gun ship, lying not far from Governor's Island. He went under ship, and attempted to fix the wooden screw into her bottom, but struck, as he supposes, a bar of iron which passes from the rudder hinges, and is spiked under the ship's quarter. Had he moved a few inches, which he might have done without rowing, I have no doubt but he would have found wood where he might have fixed the screw, or if the ship were sheathed with copper, he might easily have pierced it; but not being well skilled in the management of the vessel, in attempting to move to another place, he lost the ship.

After seeking her in vain for some time, he rowed some distance, and rose to the surface of the water, but found day light had advanced so far that he durst not renew the attempt. He says that he could easily have fastened the magazine under the stern of the ship above water, as he rowed up to the stern and touched it before he descended. Had he fastened it there, the explosion of one hundred and fifty pounds of powder, (the quantity contained in the magazine,) must have been fatal to the ship. In his return from the ship to New York, he passed near Governor's Island, and thought he was discovered by the enemy on the island. Being in haste to avoid the danger which he dreaded, he cast off the magazine, as he imagined it retarded him in the swell, which was very considerable. After the magazine had been cast off one hour, the time the internal apparatus was set to run, it blew up with great violence.

Afterwards, there were two attempts made in Hudson's River, above the city, but they effected nothing. One of them was by the abovementioned person. In going towards the ship, he lost sight of her, and went a great distance beyond her, and when he at length found her, the tide ran so strong, that as he descended under water for the ship's bottom, it swept him away. Soon after this the enemy went up the river, and pursued the boat which had the sub-marine vessel on board, and sunk it with their shot. Though Mr Bushnell afterwards recovered the vessel, he says he found it impossible at that time to prosecute the design any farther. Having been in a bad state of health from the beginning of his undertaking, and being then very unwell, the situation of public affairs became such that he despaired of obtaining the public attention, and the assistance necessary to support himself, and the persons he must have employed, had he proceeded. Besides, he found it absolutely necessary that the operators should acquire more skill in the management of the vessel, before he could expect success, which would have taken up some time, and made no small additional expense; he therefore gave over the pursuit for that time, and waited for a more favourable opportunity, which never arrived.

The art of diving has been carried to a great degree of perfection by Mr Braithwaite, who has for many years past made it a profession to search for valuable wrecks, and in this has been exceedingly successful. His great undertaking was the wreck of the Abergavenny East India ship, which was lost off Weymouth. From this, at a depth of ten fathoms, he recovered all the most valuable property, cutting through the deck, where he wished to enter, by saws and instruments worked by the people above, and directed by himself. We have been informed that he somehow obtained the diving bell, made by himself, and at others in the apparatus we have before described as the invention of Mr Tonkin. Mr Braithwaite's practical acquaintance with all kinds of hydraulic machinery, which he is constantly making for the great London breweries, gives him great advantages in these pursuits, by enabling him to contrive quickly and construct any apparatus which the work requires. See the references at the end of Divining Bell. (J. F.)
DIVING BELL.

DIVING BELL, a chest or tub, usually of a conical shape, beneath which, when inverted, divers may descend to very considerable depths under water; and though the bell is open at bottom, the air it contains prevents the water filling it, because the air cannot escape from the top of the vessel. At the same time, through the open bottom they can gain access without any obstruction to whatever they may find; and this circumstance gives the diving bell a great advantage over any other contrivance for the same purpose. Most of the successful enterprises in diving for shipwrecked treasures, have been carried into effect by the assistance of the diving bell, in preference to any other contrivance; because in it the divers have room to move, and act with perfect freedom, to employ tools for breaking into ships, removing stones, &c. They can descend two, three, or more in a company, if they wish to accomplish any great object at the bottom of the sea. It is also a great advantage, that they can carry down lights, which though not absolutely necessary, are very useful in discovering the object of the diver's search. Lastly, the bell will admit of diving in greater depths than any other method, and of a longer continuance at the bottom.

The usual construction for a diving bell, is that of a cask or tub of wood, in the form of a truncated cone, the base being open, and the smaller end well closed, as every part must be at its joints, and strongly bound by hoops on the outside. It is poised by lead weights, attached to it round the open end, till it will sink with the open end downwards, when full of air, and is so suspended by a rope, that it will descend in a perpendicular direction and no other, that the open end or lower edge of the bell may close upon the surface of the water all round at once. Seats are fixed on the inside for the divers to sit upon when they are let down into the water, beneath the shelter of the bell, from which the air cannot escape, because it is made tight in all parts except the bottom, and to get out there it must first descend beneath the surface of the water, in the bell, which will be considerably above the lower edge; for as the bell descends, the pressure of the water upon the included air compresses it into a smaller space than it before occupied, and this condensation increases with the depth from the surface, according to the weight of water acting upon it. At thirty-three feet deep, the air will be condensed into half the space, and the bell will therefore be half full of water, and the air will have an elastic pressure of two atmospheres. A man will not experience any great inconvenience from being a short time confined in such condensed air, because it is taken in by the breath, and soon insinuating itself into all the cavities of the body, has no sensible effect, provided the bell is allowed to descend slowly, to give time for that purpose. When the bell is let down suddenly, a pressure is first felt on each ear, which, by degrees, grows painful, as if a quill were forcibly thrust into the hole of the ear; but as the condensed air gains admission by degrees into the internal cavities of the ear, the pain ceases. When the bell is drawn up, the condensed air finds much easier passage from those cavities, without occasioning any pain. The force thus exerted upon the auditory passages might be expected to be prejudicial to the hearing, but experience shews that this is not the case.

A real inconvenience is experienced from the diminished capacity of the bell, which becomes filled with water, in proportion to the depth. Hence the space occupied by the air in the upper part of the bell will bear the same proportion to the lower part of it, which is filled with water, as thirty-three feet does to the depth from the bell to the surface; therefore, if the bell is at thirty-three feet depth, the two will be equal, consequently the bell will be half full of water, when the air, being crowded into such a small space, will soon become heated, and unfit for respiration, and the bell must be drawn up to recruit it, not to mention the unpleasant situation of the diver, who must be almost covered with water in the bell, and will not be able to endure the cold and pressure of the water. Respecting the air, it has been estimated, that a man can subsist an hour in a bell containing a ton, when at a depth of thirty or thirty-five feet.

This simple diving bell, which, from the defects above stated, is not applicable for diving in deep water, is by no means a modern invention. Aristotle speaks of a kind of kettle, used by divers, to enable them to remain for some time under water, but does not clearly describe the manner in which they were used. Professor Beckman informs us, that the earliest mention of the use of the diving bell in Europe, is that of John Taisnier, who was born in Hainault in 1509, and had a place at court under Charles V. whom he attended on his voyage to Africa. He relates, in what manner he saw, at Toledo, in the presence of the emperor and several thousand spectators, two Greeks let themselves down under water, in a large inverted kettle with a burning light, and rise up again, without being wet. It appears that this art was then new to the emperor, and the Spaniards, and that the Greeks were requested to make the experiment, in order to prove the possibility of it.

In an old book on fortification, by Lorini, he describes a diving machine, consisting of a square box, bound round with iron, and furnished with windows; it has a stool affixed in it for the diver. The contrivance is probably older than this Italian writer, as he does not pretend to be the inventor of it. From this time the diving bell was frequently employed to recover valuable wrecks, but from the defects above described, it could not be used in great depths. It was not until Dr Halley began his experiments, that adequate remedies were provided. This ingenious philosopher invented means to convey air down to the diving bell, whereby not only the included air is renewed for breathing, but the whole of the water is kept out from the bell, whatever the depth may be, and air may be furnished in any desired quantity. He describes his apparatus in the following manner, in the Philosophical Transactions:

"The bell I made use of was of wood, containing about sixty cubic feet in its concavity, and was of the form of a truncated cone, whose diameter at top was three feet, and at bottom five; this I coated with lead, so heavy that it would sink empty, and distributed its weight about its bottom, so that it would go down in a perpendicular situation, and no other; in the top I fixed a strong but clear glass, to let in the light from above, and likewise a cock to let out the hot air that had been breathed; and below, about the hinder part under the bell, I placed a stage, which hung by three ropes, each of which was charged with about one hundred weight, to keep it steady. This machine I suspended from the mast of a ship by a spreit, which was sufficiently secured by stays to the mast head, and was directed by braces to carry it over board, clear of the ship's side, and bring it again within board.

To supply air to this bell, when under water, I air barrels caused a couple of barrels, of about thirty-six gallons.
Diving Bell.

each, to be cas'd with lead, so as to sink empty, each having a bung hole in its lowest part, to let in water as the air in them condensed, on their descent, and to let it out again, when they were drawn up full of water from below, and to a hole in the uppermost part of these barrels I fixed a leathern trunk, or hose, well liquored with bees wax and oil, and long enough to fall below the bung hole, being kept down by a weight appended, so that the air in the upper part of the barrels could not escape, unless the lower ends of these hose were first lifted up.

I fitted these air barrels with tackle proper to make them rise and fall alternately, after the manner of two buckets in a well, which was done with so much ease, that two men with less than half their strength could perform all the labour; and in their descent, they were directed by lines fastened to the under edge of the bell, which passed through rings placed on both sides the leathern horse of each barrel, so that sliding down by those lines, they came readily to the hand of a man who stood on the stage to receive them, and to take up the ends of the hose into the bell. Through these hose, as soon as the ends of the pipes came above the surface of the water, in the barrels, all the air that was included in the upper parts of them, was blown with great force into the bell, whilst the water entered at the bung holes below, and filled them. As soon as the air of one barrel had been thus received, upon a signal given it was drawn up, and at the same time the other descended; thus, by an alternate succession, furnishing air so quick, and in such plenty, that I myself have been one of five who have been together at the bottom, in nine or ten fathoms water, for above an hour and a half at a time, without any sort of ill consequence; and I might have continued there as long as I pleased, for anything that appeared to the contrary. Besides the whole cavity of the bell was kept entirely free from water, so that I sat on a bench which was diametrically placed near the bottom, with all my clothes on; I only observed that it was necessary to let down gradually at first, as about 12 feet at a time, and then to stop and drive out the water that entered, by receiving or four barrels of fresh air, before I descended farther; but being arrived at the depth desired, I then let out as much of the hot air that had been breathed, as each barrel would replenish with cool, by means of the cock at the top of the bell, through whose aperture, though very small, the air would rush with so great violence, as to make the surface of the sea boil, and to cover it with a white foam, notwithstanding the great weight of water over us.

Thus I found I could do any thing that was required to be done just under us, and that by taking off the stage, I could, for a space as wide as the circuit of the bell, lay the bottom of the sea so far dry, as not to be over shoes thereon; and, by the glass window, so much light was transmitted, that when the sea was clear, and especially when the sun shone, I could see perfectly well to write or read, much more to take up any thing that was under us; and, by the returns of the air barrels, I often sent up orders, written with an iron pen, on small plates of lead, directing how to move us from place to place; at other times, when the water was troubled and thick, it would be as dark as night below; but in such a case I have been able to keep a candle burning in the bell as long as I pleased, notwithstanding the great ex pense of air requisite to maintain flame.

I take this invention to be applicable to various uses such as fishing for pearls, diving for coral, sponges and the like, in far greater depths than has hitherto been thought possible; also for the sitting and plain ing of the foundation of mole{s}, bridges, &c. upon rocky bottoms, and for the cleaning and scrabbling of ships' bottoms, when foul, in calm weather at sea.

It was by this contrivance of Dr Halley's to send down fresh air to the diving bell, that it was rendered a useful and practicable mode of recovering treasures at considerable depths. In other situations it had before been successfully employed. In a work printed at Rotterdam in 1689, and entitled G. Sinclairi Ars nova et Magna Graevitatis et Lenitatis, there is given an account of a kind of diving bell, used by a person who recovered some cannon from the wrecks of several ships of the celebrated Spanish Armada, which were sunk on the western coast of Scotland near the Isle of Mull, just after the English had dispersed them in the channel in 1588. The report of the riches they contained was a constant excitement to speculative to recover the treasure, and many attempts were made, without success. The person who made the preceding attempt did not recover sufficient to defray his expenses.

William Phipps, a native of America, submitted a project to King Charles II. in 1680, for searching and unloading a rich Spanish ship, sunk on the coast of Hispaniola. He represented his plan so plausibly, that the king gave him the command of a ship, and furnished him with every thing necessary for the undertaking. He set sail in the year 1683, but being unsuccessful, returned again in great poverty, though with a firm conviction of the practicability of his scheme. By a subscription promoted chiefly by the Duke of Albemarle, the son of the celebrated Monk, Phipps was enabled, in 1687, to try his fortune once more, having previously engaged to divide the profit, according to the 26 shares of which the subscription consisted. At first all his labour proved fruitless; but at last, when his patience was almost exhausted, he was so lucky as to bring up, from the depth of six or seven fathoms, so much treasure, that he returned to England with the value of £200,000 sterling. Of this sum he himself got about £16,000, others say £20,000, and the Duke £90,000. After he came home to speak of his experience and success, the king was induced to use his influence with the Lords of the Trinity House, and to make the necessary steps to enable the new comers to seize both the ship and the cargo, under a pretence that Phipps, when he solicited for his majesty's permission, had not given accurate information respecting the business; but the king answered, with much greatness of mind, that he knew Phipps to be an honest man, and that he and his friends should share the whole among them had he returned with double the value. His majesty even conferred upon him the honour of knighthood, to show how much he was satisfied with his conduct. The construction of Phipps's apparatus is not known.

In 1791, soon after Dr Halley made the descent above related, he invented additional apparatus to enable the diver to go out from the bell to a considerable distance, and stay a sufficient time in the sea, and walk about on the bottom, with full freedom to act as occasion required. Considering that the pressure being greater on the surface of the water in the bell, than on any other surface which was higher than that in the bell, the air would pass by a pipe from the bell into any cavity for air; where the surface of the water was higher, he concluded, that a man by putting on his head a bell or cap of lead, made sufficiently heavy to sink empty, and in form resembling the bell itself, might keep his head dry, and might receive a constant stream of air from the great bell, so long as the surface of the
water in the cap was above the level of that in the bell, by means of a flexible pipe which he could carry coiled on his arm.

In pursuance of this idea, he procured pipes to be made, which answered all that was expected from them. They were secured against the pressure of the water by a spiral brass wire, which kept them open from end to end, the diameter of the cavity being about the sixth part of an inch. These wires being coiled with thin glove leather, and neatly sewed, were dipped into a mixture of hot oil and bees wax, which, filling up the pores of the leather, made it impenetrable to water; several thicknesses of sheep’s entrails were then drawn over them, which, when dry, were covered with paint, and then the whole defended with another coat of leather to keep them from fretting. Several of the pipes were as much as forty feet long, the size of a half inch rope; one end of a pipe being fixed in the bell at some height above the water, the other end was fastened to a cock which opened into the cap. The use of the cock was to stop the return of the air whenever there was occasion to stoop down or go below the surface of the air in the bell, which occurred as often as there was occasion to go out or return into the machine. The diver, therefore, when he has descended to the bottom in the great bell, puts on his cap with the pipe hanging on his arm like a coil of rope. As soon as he leaves the bell, he opens the cock in the pipe, and walks on the bottom of the sea, giving out the coils of his pipe as it is required; and this serves as a clue to direct him back again to the great bell, from whence he derives his supply of air by means of the pipe.

The weight of a man being very little more than that of his bulk in water, he could not act with any strength, nor stand with any firmness, especially if there is any current, without a considerable addition of weight; the leaden caps were therefore made to weigh about half a hundred weight, to which was added a girdle for the waist, formed of large weights of lead nearly of as great weight in the whole; also two clogs of lead for the feet of about 12 pound each. With this accession of weight, Dr Halley found a man could stand well in an ordinary stream, and even go against it. It is necessary for the diver to be provided against the cold of the water, which, though it could not be removed so that a man could endure it long, yet it was much eased, by wearing a waistcoat and drawers made close to the body, of that thick woollen stuff of which blankets are made; this becoming full of water, would be a little warmed by the heat of the body, and keep off the chill of new cold water coming on.

When the water is not turbid, things are seen sufficiently distinct at the bottom of the sea; but a small degree of thickness makes perfect night in a moderate depth of water. To obtain an open view from the leaden caps, which, from their use, the Doctor called caps of maintenance, he at first used a plain glass before the eyes, but soon found that the vapour of the breathing obstructed such a view of the surface of the glass, that it lost its transparency; to remedy this, he found it necessary to prolong that side of the cap which was before the eyes, and thereby enlarge the prospect of what was beneath.

Mr Martin Triewald, who was military architect to the king of Sweden, proposed another form of the diving-bell adapted for a single diver, which, being on a small scale, may be made at a less expense than Dr Halley’s, and drawn up with more convenience. It is represented in Fig. 8. Plate CXXXI. The bell AB is made of thin copper plate, tinned on the inside, and strengthened without by bands of iron hoop arranged in different directions. It is suspended by a rope C, from the ring A at the top, and caused to sink perpendicularly by weights DD suspended from the bottom hoop, as well as by a large iron ring or plate E, which is suspended at such a distance from the bottom of the bell by chains, that when the diver stands upright with his feet upon this plate, his head is above the water in the bell. This situation is better than if his head was in the top part A of the bell, the air being cooler and more pure near the surface of the water than higher up, because the air which has been breathed is heated, and rises up to the top; but when it is necessary for the diver to rise up into the top of the bell, the inventor has provided him the means of drawing up the cool air from the bottom near the water. This is a spiral copper tube, shown by the dotted lines b c. It is placed round the inside of the bell, the lower end opening in the bottom of the bell, and the upper end provided with a flexible leather tube ending in an ivory mouth-piece d, for the diver to hold in his mouth and inspire the air from below; whilst at every expiration he throws out the air through his nostrils into the upper part of the bell. This bell may be supplied with fresh air from barrels in the same manner as Dr Halley’s; and is therefore provided with a cock in the top to allow the impure air to escape when a fresh supply is obtained. It is illuminated by four strong lenses in the top, at GGG, each provided with copper shutters, to defend them from accidents when on shore.

Several important improvements were made in the diving bell in 1776, by Mr Spalding of Edinburgh, for whom the Society of Arts presented a reward for the invention. This gentleman had in the two preceding years, acquired considerable experience in the management of a bell on Dr Halley’s plan, which he had constructed, in the hopes of recovering some of a considerable property which was lost in a ship that was wrecked on the Scars, or Fern Islands, in 1774, in the night, when all the crew perished. Some of the light goods were thrown on shore; and it was proposed to recover the rest by diving, the remainder of the owners giving up the management of the whole to Mr Spalding. His first experiments were made in depths of 5, 6, and 8 fathoms in Leith roads; and having in these made his apparatus tolerably perfect, he sailed for Dunbar, thirty miles distance, in an open long boat, sloop rigged, and of about six or eight tons burthen. By a mistaken account, he had been informed the bottom of the Fox ship of war lay there; but upon his arrival, the oldest seaman in the place could give him no intelligence, as that vessel perished in the night, with all on board, somewhere in Dunbar bay, and by storms, during so long a period as thirty years, was thought to be drenched. In order to gratify the curiosity of some friends there, he still determined to descend where it might be thought probable her bottom lay; but in seven and eight fathoms water found nothing but a hard sandy bottom, from whence he was led to conjecture, that the proprietors of the valuable effects which were on board that vessel, might have found their account in sweeping for her. Being informed that a vessel, which was thrown up by accident in the river Tay, near Dundee, with a large quantity of iron, lay within two fathoms of the surface at low water, he determined to make trial there, and accordingly sailed across the Frith to that place; about fifteen leagues distant from Dunbar. Here he went down three different times, changing the
ground at each going down, and at last fell in with a
stump of the wreck, sunk five fathoms deep at low wa-
ter to a level with the soft bed of the river, which is
composed of a light sand intermixed with shells. The
principal parts of this wreck were supposed to have been
carried away by an immense body of ice the year be-
fore. He found, that the mudliness of the river oc-
casions a darkness at only two fathoms from the surface
that cannot be described; and from the smallness of
his machine, which contained only forty-eight English
gallons, it was impossible to have a candle burning in
it, which would consume the air too quickly for any
man to be able to work, and at the same time pay at-
tention to recovering the necessary supplies of air.

These trials were only preparatory to his views at
the Scares, hoping to acquire experience, which would
enable him to surmount the dangerous difficulty of the
unequal rocky bottom which he expected to meet with;
but in the preceding trials, and different alterations of
the machinery, so much time had been lost, that the
weather became stormy, and he was obliged to wait at
Bamborough Castle some time, till the weather became
more favourable. He then sailed to the Scares, with his
brother, three sailors, and two pilots. It was four in the
afternoon, about high water, when he went down at
a small distance from the place, where he judged
the wreck to lie. The depth was about ten fathoms.

He fortunately alighted on a flat part of the
rock, within a small space of a dreadful chasm, and had
just gone two steps with his machine, when the terror
of the two pilots was so great, that, in spite of his bro-
ther, they brought him up very precipitately, before he
had in any degree examined around him. On coming
into the boat, they remonstrated on the danger of the
machine being overturned either on the wreck or the
rocks, and also on the impossibility of raising any of
the weighty goods with so small a purchase in an open
boat, and in a place where, at this season, no large
vessel would venture to lie, as the nights were then so
long, and only two passages for a small vessel to run
through, in case of a gale of easterly or southerly wind;
one of the passages being extremely narrow, and both
of them dangerous.

Convinced from this, says Mr Spalding in his ac-
count, ‘that with an open boat nothing could be ac-
complished, and that, except in June and July, no
man would risk himself with me in a sloop, to continue a
few days and nights at anchor there, I was obliged to
abandon my project; yet I determined to take a view
of the guns of a Dutch ship of war lost in the year
1704, and as they lay two or three miles nearer the
land, I could execute this design with less difficulty,
especially as the weather continued still favourable.
Having procured all the intelligence possible, we went
to the place, where I went down four different times,
but could find no marks of any wreck, notwithstanding
my walking about in five and six fathoms water, as far
as it was thought safe to allow the rope to the bell,
continuing generally twenty minutes each time at the
bottom. On this occasion I was obliged to carry a cutting
hook and knife, and clear away the sea weeds, which at
this place are very thick and strong; without this me-
thod I could not move about. At the fifth going down,
each trial being in a different place, I was agreeably
surprised to find a large groove of tall weeds, all of them
from six to eight feet high, with large tufted tops, mostly
in regular ranges, as far as the eye could reach, a
variety of small lobsters and other shell fish swimming
about in the intervals." He then discovered the place
where one of the cannons lay; but was too much ex-
hausted, by having been down at intervals for near
three hours, to attempt bringing it up.

In these descents, Mr Spalding found out two very
serious dangers attendant on the use of the bell, in Dr
Halley’s plan. These are, First, by Dr Halley’s construc-
tion, the sinking or rising of the bell depends entirely
upon the people who are at the surface of the water;
and as the bell, even when in the water, has a very
considerable weight, the raising of it not only requires
a great deal of labour, but there is a possibility of the
rope by which it is raised breaking; and this every
person in the bell would inevitably perish. Secondly,
As there are, in many places of the sea, rocks which
lie at a considerable depth, the figure of which cannot
be perceived from above, there is danger that
some of their ragged prominences may catch hold of
one of the edges of the bell in its descent, and thus over-
set it before any signal can be given to those above,
which would infallibly be attended with the destruction
of the people in the bell, especially as it must always
be unknown before trial what kind of a bottom the sea
has in any place.

Mr Spalding made such additions to Dr Halley’s bell
as completely obviated these defects. They will be ren-
cered evident from the following description: ABCD,
Fig. 6, is the body of the bell, made of pipe staves, five
feet long, five feet diameter at bottom, and two and a
half at top. It is suspended by four ropes e, e, attach-
ed to hooks, fastened on the sides of the bell, and meet-
ning at the top where the hook of the great rope Q takes
them. e, e, are the ballast weights, suspended from
hooks on the outsides. These keep the mouth of the
bell always parallel to the surface of the water, whether
the machine, taken all together, is lighter or heavier
than an equal bulk of the fluid. By these weights alone,
however, the bell would not sink; another is there-
fore added, represented at L, and which can be raised
or lowered at pleasure, by means of a rope passing over
the pulley a, and fastened to one of the sides of the bell
at M. As the bell descends, this weight, called by Mr
Spalding the balance weight, hangs down a consider-
able way below the edge of the bell. In case the edge
of the bell is caught by any obstacle, the balance weight
is immediately lowered down, so that it may rest upon
the bottom. By this means the bell is lightened, so that
all danger of oversetting is removed; for being lighter
without the balance weight than an equal bulk of wa-
ter, it is evident that the bell will rise as far as the
length of rope affixed to the balance weight will allow
it. This weight, therefore, will serve as a kind of an-
cchor to keep the bell at any particular depth which the
divers may think necessary; for being let down to the
bottom before the bell descends, the diver by hauling
the rope will descend, though he does not raise the
weight. Instead of wooden seats or stage used by Dr
Halley, Mr Spalding made use of ropes, suspended by
hooks b, b across the bottom of the bell; and on these
ropes the divers may stand without any inconvenience.
Two windows, made of thick strong glass, are fixed near
the top of the bell, for admitting light to the divers.
T, N represent the two air casks, with their tackle; and
OCP the flexible pipe, through which the air is ad-
mitted to the bell: the casks contain 40 gallons each.
In the ascent and descent of this cask, the end of the pipe
is guided by the lines M, extended from the bell to the
ship above. The ends of the pipes are kept down by
a small weight appended, as in Dr Halley’s machine;
or what is better, they may have cocks as at P. R is a
DIVING BELL.

Diving Bell. cock, by which the hot air is discharged as often as it becomes troublesome, and a fresh supply is obtained from the air casks.

Spalding's double bell. By another very ingenious contrivance, Mr Spalding rendered it possible for the divers to raise the bell, with all the weights appended to it, even to the surface, or to stop at any particular depth as they think proper, and thus they could still be safe even though the rope designed for pulling up the bell was broke. This was accomplished, by affixing a second bell of smaller dimensions over the large one, as shown at S, being fixed thereto by screws at different places as well as by the ropes c, e, which suspend the bell. It contains 25 gallons. In the top of it is a cock t, which can be opened by the diver, to permit the air to escape from the upper bell. Its handle comes down through the great bell through the top at t. There is also another cock at v in the top, which permits the air to pass out of the great bell, and rise into the small one. There is so much space left between the two bells, that the water has free entrance into the upper as well as into the lower one. When the bell is first let down the cock t in the top of the upper one is opened, and therefore the air escapes from it, and the water enters till it is full. In this state the bell is, as before mentioned, lighter than an equal bulk of water without the balance weight, though with the addition of that it is heavier. Now if the divers wish to raise themselves, they turn the small cock v, by which a communication is made between the bells. The consequence of this is, that a quantity of air immediately enters from the lower into the upper bell, and forces out a quantity of the water contained therein. The air, which is thus let out from the lower bell, must be immediately replaced from the air barrel, and thus renders the bell lighter, by the whole weight of the water which is discharged. The air is to be let out very slowly, otherwise the bell will rise to the top with so great velocity, that the divers will be in danger of being shaken out of their seats. The quantity let into the upper bell will determine the rate of its ascent. Thus, if a certain quantity of air is admitted into the upper cavity, the bell with the balance will descend very slowly; if a greater quantity, it will neither ascend nor descend, but remain stationary; and if a larger quantity of air is still admitted, it will rise to the top.

Indeed the bell would rise very slowly when the air is admitted, from the lower into the upper cavity, from another cause, independent of taking in any more air from the barrel. Thus the air in the great bell is condensed, by the pressure of a certain column of water. Now when a portion of the contained air is transferred to the upper bell, that quantity is pressed by a column of water of 5 or 6 feet less altitude than it was before, because the upper bell is that height above the other, consequently it will expand itself, and displace rather a greater quantity of water from the upper bell than its absence from the lower one admits into it.

By following these directions, every accident may be prevented, and people may descend to great depths without the least apprehension of danger. The bell also becomes so easily manageable in the water, that it may be conducted from one place to another by a small boat with the greatest ease, and with perfect safety to those who are in it.

We consider Mr Spalding's form of the diving-bell as the best adapted of any which has been yet made public for descending deep into the sea. It may be made of one single cask instead of two. In this case, it must have a false bottom, to divide it into two cavities, the air being allowed free entrance into the lower part of the upper one, through a number of auger holes bored through the staves, close above the partition. The inventor's reason for making them separate, was, that he might disencumber his bell of the small one when he did not think it necessary to employ it.

The writer of this article having had occasion to consider the best means of diving to a wrecked ship, in a considerable depth of water, conceived a very material improvement upon Mr Spalding's plan, of dividing the bell into two cavities, so that it can at all times be made heavier or lighter, as the divers wish. At the same time, he drew up a plan for such a system of tackle for the management of any kind of bell, either at sea or in a river, as would greatly facilitate its operation; for the success of diving, with any kind of bell, will greatly depend upon the convenience of its tackle, that it may be let down or drawn up, and removed in any direction on the bottom with the least possible loss of time; for as it is found injurious to divers to remain a long time in the condensed air when the depth is very great, if much time is expended in getting to the required situation, they will be unable to do anything before they find it necessary to return to the surface, to relieve themselves from the pressure. This improvement of the bell consists in making the upper chamber quite tight, and of considerable strength, having no openings to admit water as in Mr Spalding's machine. It is furnished on the under side with two small brass forcing pumps fixed in the partition which forms the chamber, and provided with proper valves and pistons, as well as levers with handles for the divers to work them by, and force air into the upper chamber from the bell. The valves of these pumps where they pass through the partition, will permit the air from the bell to enter the chamber when the pressure below is the greatest, but always prevent it from returning. There is a cock in the partition, to allow the air to descend at the pleasure of the diver. The action of this chamber is as follows: When the divers have descended to a certain depth and then stop, as Dr Halley describes, to have as much air as Mr Spalding's will supply them, the supply will be diminished by the compression of the contained air, they are to work these pumps, to condense as much as they can of the air into the upper chamber, having the quantity which is thus taken from the great bell immediately replenished from the air barrel. By repeating this every time they stop, and also when they arrive at the bottom, they obtain a store of fresh air in reserve for two purposes: First, if by any accident the air barrel, or any part of its tackle, should fail, and interrupt the supply of air, they can let out a quantity of air from the upper chamber, to serve them till the tackle is repaired, or till they can be drawn up. It also gives them the means of adjusting the weight of the bell in a more perfect manner than Mr Spalding's. Thus, if the ballast is so adjusted, that when the bell is full of air all but 6 inches of the lower part, its weight without the balance weight is rather lighter than water, so as just to rise but no more, the diver may manage to hold it down or descend, by pulling the balance weight rope with a very slight force. Now in this case, if they require to rise without the aid of those above, they open the cock, let out of the chamber as much air as will expel the water from the 6 inches of the lower part of the bell, and thus by displacing more water rendering it sufficiently buoyant to rise to the surface, and carry the balance weight up with it if required. They have,

Air vessel and pumps. Their use and action.
Defect of Spalding's Bell

The means of coming up at any time; whereas in Mr Spalding's bell, they can only take the opportunity of a cask of air being sent down, to introduce so much of air into the upper bell as will carry them up; and even this would be very dangerous to attempt, for a reason which the ingenious inventor seems to have overlooked. Thus suppose, when at the bottom in 66 feet water, the great bell is quite full of air at a pressure of three atmospheres. Now if the small bell is half filled with air, to give the buoyancy required to raise the bell, it will ascend, but at every foot of rise the pressure diminishes, and the air expands itself. That in the great bell escapes, by bubbling out under the bottom; but in the upper one it continues to displace more and more water, giving the bell an increasing power of ascent till at 33 feet depth, when it will have a pressure of only two atmospheres. The small bell will be quite full, thus giving to the bell a power of ascent twice as great as it began with, and producing an accelerated motion which the divers would find it difficult to control: for, though it might be done, by letting out the air from the upper bell by degrees, it would be hazardous, because if they once let out too much, so as to destroy the power of ascent, the bell would sink, and never have the means of rising again.

On the proposed plan with air pumps, this could never happen: for, if the divers found themselves too buoyant, they could by the pump return as much air into the chamber as would restore the equilibrium. Lastly, in Mr Spalding's, if they get any air into the upper chamber to give them a power of ascent, they depend altogether upon the exertions of the man who holds the balance weight rope to keep them down, and if this should break, they rise with a dangerous velocity.

This bell for diving to wrecks of ships, should be made to contain two persons. Its most convenient form will be that of the frustum of an elliptical cone; its base to be 6 feet by 4; the top 3 feet 6 inches by 2 feet 6 inches; and 6 feet 6 inches in height. If it is to have the air chamber formed by a partition in the top, to receive the air condensed by the pumps. As this vessel will require to be very strong, it would be best made of thick sheet copper, and fixed in the top of the bell against its crown, being rather smaller than the bell, and in the form of a hemisphere. It will leave a space all round, of a similar form to that of the bottom of a green glass bottle between it and the sides of the bell. By this means the vessel will not obstruct the light which enters at the windows, made round in the side of the bell at the top, or prevent it proceeding down to the divers. This space round the air vessel also receives the hot air which has been breathed; and the cock to let it off is in the very highest part. The pumps should have almost all the length of their barrels contained within the copper vessel, and should have proper levers, with handles to work them, situated conveniently within the diver's reach. As the bell requires to be loaded with a great weight, the best plan of all, where expence is not regarded, is to make the whole of cast iron, and then its strength will be much greater, and without any danger of leakage. The chamber in the top may then be cast in one piece with the crown. The windows should be convex lenses of glass, such as are now used in ships decks, being complete hemispheres on the outside, and plains on the side which is within. They concentrate the light from all directions, and throw it in the bell. The sides should be painted white within to reflect the light, and also on the outside, that it may be visible to those in the ship as long as possible when under water.

To find the direction in which they would be moved, the divers should have a compass hung up in the bell. The most convenient will be that kind, which captains of ships usually have hung from the ceiling of their cabins. The centre pin of the needle being fixed in the glass of the box, the card can be seen from beneath. It will be satisfactory to the divers to know at what depth they are from the surface; and for this purpose a gauge, represented in Fig. 6, should be fixed within the bell. It is a glass tube $a b$, hermetically sealed at the top, and at the bottom cemented into a metal tube $b$, which turning at right angles, has a screw to fix it into the side of the bell. To defend it from injury, the tube is bedded in a piece of board, which has divisions and feet marked upon it, to show how high the water rises in it; for it is by this that the depth or pressure is shewn, because the water entering freely into the lower end of the tube, condenses the air in the glass tube into a space proportional to the intensity of the pressure. Thus at 33 feet deep, the water will rise up half way to the top of the tube; at 66 feet two-thirds; at 93 three-fourths. It is, therefore, upon this principle that the divisions are made; or if any doubt is entertained as to the glass being perfectly cylindrical, it may be done by the experiment of letting down the bell to a known depth, and marking how high the water rises. The figures 1, 2, 3, &c. on the other side, opposite the several figures 33, 36, 93, &c. shew the compression of the air at those depths to be equal to 1, 2, or 3 atmospheres; or what is the same thing, that the air in the tube or in the bell is condensed into one-half, one-third, &c. of the space it occupied above. After all, this instrument is rather a matter of curiosity than utility, because should it be ever so accurately divided, the variations of the atmosphere will render it untrue; for if the air, with which the tube is filled before the descent, has a greater or less density, (as the barometer shews it has,) it will take more or less than 33 feet of water (the weight of which always continues the same) to condense the air into half the space: hence the scale will constantly vary.

The tackle proposed for suspending and managing the bell is as follows: If it is to be used at sea, it may be hung from the yard-arm of any ship which carries a square mainsail. The bell rope may pass through a block at the extremity of the yard; then being led through another block at the slings or middle of the yard, so as to come down close to the mast, it may be conducted by a match block on the deck, for the men to haul it by hand, or by the ship's windlass, though the capstan will be better if she has one. If there is a stream, the ship should be moved by the head with two cables at an angle, so that by taking up one, and giving out the other, she may be moved sidewise, to sweep the bell along the ground to search for any thing; or by taking up or giving out both at once, she will be moved in an opposite direction. When the place of the wreck is found, and it is only requisite to move it a few feet in the latter direction, it may be very conveniently done by braiding the yard, to carry it fore or aft by the same braces or tackles which are used in the sailing of the ship; and the bell rope being conducted down from the yard close to the mast, in the same manner as the topsail sheets are, it will neither be taken up or let down at all by this motion of the yard-arm from which the bell is suspended.

If there is a steady and moderate breeze, the ship may ride with one anchor, and shift her position by the sails and rudder to the required station. By their compass,
Diving Bell. divers find the direction in which they wish to be moved, and can communicate orders to those above by a signal line tied below to the bell, and going up to the ship, when some intelligent person must hold it in his hand, to feel the signals which the divers make by snatching it. To avoid the danger of mistakes, the signification of these signals should be painted round the inside of the bell. Thus one snatch signifies, make the bell rope fast to keep it stationary; two, means to descend; three, to ascend; four, to the north; five, to the south; six, to the east; seven, to the west. A board, with duplicates of all these, is to be kept near the person above, who will be very conveniently situated a-stride upon the yard-arm, so as to be directly over the bell, and will there have a view of all the ship's company, as well as the bell under water. The signal line should be a deep sea lead-line, such as seamen use to sound in deep water, with the usual marks to know the depths. These will show how far the bell is below the surface, and will be attended with the advantage of enabling the divers to denote the distance they wish to move, ascend or descend. Thus if they gently pull down two fathoms of the line, which the man above must give out, and take notice of the quantity, he will find they wish to descend two fathoms lower; the same of ascent, or progression sidewise, in any direction by the compass. To avoid confusion or delay, those of the ship's crew who are to haul the ropes for motion, ascent, and descent of the bell, should in all things be under the command of this man, and no other; but another should undertake the command of the people who manage the supply of air. He may be placed with great advantage in a boat, where, if he has another to assist him, he may be able to do the whole; for the barrels weigh very little in descending, and in ascending only as much as their bulk of water, which need not be above 20 gallons. Indeed as Mr Spalding says, one barrel of 30 gallons would be sufficient; and we think it would be more easily managed than two smaller ones.

Diving Bell.

The boat should have a piece of timber projecting several feet over her stem or side, in the manner of a ship's cat-head, or rather of an anchor boat, with sheaves in it at the end for conducting the rope for the air-barrel to a small roller with a winch, by which it is drawn up with very little labour.

The upper end of the leading line for conducting the air pipes down to the bell, should be led through a sheave in the timber, at a proper distance from the others, and should be held by the person above mentioned, who must take care to keep it always tights, giving it out when the bell descends, and taking it in when it is drawn up.

If the divers have any directions to give concerning the supply of air, they should do it by snatching this leading rope, and not the signal line, because the orders will then be sent to the proper person, viz. he who commands the boat. Thus his man winds up the barrel, till it comes above water, and fills with air, by the water running out at the open bung-hole in the bottom; then he lets it down again full of air, and the end of the flexible pipe is guided by the thimble running down the guide-line till it comes to the bell, where one of the divers takes it in, and opens the cock in the top of the bell to let out the air, till he sees the water rise in the bell to certain marks, by which he knows he has let out the exact quantity of air which the air barrel will replenish. As soon as the barrel has descended below the level of the surface of the water in the bell, he opens the cock in the end of the flexible pipe to admit the air from the barrel; but he must not do this before the barrel has become lowest, lest the bell air should take a contrary passage, and-issue through-the pipe from the bell into the barrel, and perhaps escape from its bottom into the sea. The cock at the end of the pipe is likewise very useful to admit the air gradually, lest by entering the bell, and suddenly displacing that quantity of water, which was just before gradually admitted when the hot air was let out, it should cause the bell to heave up. When the bell rests upon the ground or the deck of a ship at the bottom, it will be necessary to draw it up a little, to allow the air barrel to go lower and get the air into it; it will give a great facility to this, if the bell is made as above described, with pumps and a chamber above: then if this let out so much air from it as will make the bell, without its ballast or anchor weight, lighter than water, the divers, by letting out the rope of the balance weight, may suffer the bell to rise 3 or 4 feet without waiting to give orders to those above; the air being thus introduced from the barrel into the bell, they return the air to the chamber by the pumps; and if this does not cause it to descend, they haul it down again by the balance weight, then giving a snatch to the guide rope, the man in the boat feels it, and knows he is to haul up the air barrel to refill it with air.

To proceed with advantage, two divers should descend together, as they will then be able to manage with more confidence and expedition than if there was only one. The principal diver must be a man possessing great intrepidity and presence of mind, that he may proceed calmly to effect his purpose: He should be perfectly acquainted with every thing belonging to the bell, and the principles of hydraulics on which it acts, so as to have resources within himself for all that may occur; his companion should be completely under his direction to execute his orders, and should be an intelligent man, well acquainted with the management of the air barrel and the balance weight, which are to be his chief occupations, unless when his principal has other work for him to do, such as fastening up the ropes to the goods, and assisting in cutting away the deck of the wreck. For these purposes, the bell should be well furnished with tools, that nothing may be found wanting: a crow-bar, two axes, proper saws, and a large augur or centre bit are indispensible. One of the axes should be made exceedingly sharp, and kept for cutting away ropes from the ship's rigging, which are very dangerous to the bell in descending. These tools may be kept at the sides of the bell, hung in loops formed by leathern straps nailed upon the wood; there should likewise be provided a strong iron screw formed to penetrate and hold in wood, with an eye at the end. The divers should be dressed in thick flannel dresses, with high water boots to keep their feet dry. Each man may have a small rope made fast round his waist, and to the top of the bell, with sufficient length to allow him to work, but not to sink deep in the water if he falls. They should stand upon ropes stretched across the mouth of the bell, and have others fixed at a proper height to sit upon; also several fixed across the top of the bell, and hanging down a little to take hold of, in case of accident, as well as to obtain a hold for the purpose of lifting heavy goods, when they are clearing the wreck. If they intend to dive to the wreck of a ship, the diver should...
Diving Bell.

Previously make himself acquainted with every part of the ship's rigging and hull, also the manner in which the timbers are disposed, that he may know when he alights on any part of the ship's hull or upper works, where he is, the position in which she lies, also how to proceed to cut an entrance, if it is not practicable to enter at the hatchways. Having obtained information from persons best acquainted with the situation of the wreck, he should proceed to the place and moor his ship, so that the sun if it shines will be on that side of the ship where he intends to descend, otherwise her shadow on the bottom might fall on the wreck and throw him in the dark. Before he descends the first thing he should ascertain, by sounding, the most proper place for the descent, and there let down the balance weight of the bell to the bottom; then, with his assistant, he enters the bell, which we suppose is suspended from the yard arm, and standing upon the cross ropes, he orders it to be lowered gently into the water. When the air becomes much condensed by 10 or 15 feet descent, he must stop, and have as many barrels of air sent down as will fill up the bell again, and also as much as they can pump into the air vessel. The quantity of ballast is such that, in this state, it will not quite sink, and therefore requires the diver to haul it down by means of the balance-weight, which should be at least two and a half, or three hundred weight, so that it will cause the bell to sink, without being taken off the ground. By this means the divers govern the bell themselves, and the men in the ship above are directed, by the proper signal, to hold the bell rope just tight, so as to be ready if wanted; but they are to give it out as they feel it drawn by the descent of the bell, which is thus continued with perfect safety; for if the divers meet with any rope or spar of the ship or point of a rock, which puts them in danger of being swayed, they cease hauling the rope, to give the signal of stand fast to those above, and wait till they cut away or remove the obstruction; or if this cannot be done, they haul up their balance-weight off the ground, send orders to be drawn up a few feet, and then moved to the north, south, &c. many feet as they expect will bring them over the spot they desire. Here they again let fall their balance-weight, give the signal for let go the bell rope, and haul themselves gently down, stopping when they require more air, and making a signal for it to the man in the boat, by snatching the guide line of the air barrel. In this way they proceed till they come within sight of the bottom; and when they arrive there, the diver makes his observations on the position of the vessel; and if he wishes to move from his position, he orders to stand fast, hauls up the weight, and causes himself to be removed wherever he wishes, till having settled his plan of operation, and chosen a place to begin, he must, as the first thing, secure the means for descending to the same spot the next time. If he thinks he cannot accomplish his object at once, and if he must cut through the ship's deck or side, this is not to be expected; he therefore makes an augur hole in some part of the wood of the wreck, and screws the iron screw above mentioned fast into it, by turning it round with the crow bar; then into the eye of it he hooks the block of the balance-weight, or lashes the weight fast to it, so that it can be in no danger of removal. The divers then set earnestly to work to cut a hole either with their saws or other tools, as are best adapted to the purpose; but they should not continue down too long, because it is very injurious if the depth is great. When they are drawn up, or rather when they suffer the bell to rise, by giving away the rope of their balance-weight, the air in the Diving Bell will expand itself as the pressure diminishes, and bubble out from under the bottom of it; but if they find that the expansion of the air in the upper bell, by displacing more water, gives the bell too much power of ascent, they must let some of it out by the cock for that purpose, and thus regulate their ascent.

When the bell is hauled up out of the water, the divers quit it, getting into the boat, which is rowed beneath for that purpose, and other divers may descend immediately to continue the work; but if this cannot be done, and the ship is obliged to leave the station, the upper balance-weight block should be unhooked from the top of the bell, and made fast to a proper buoy or float, by which it can be found again when they return another time; then by applying the block to the bell, it may be taken direct to the bottom without any danger of obstructions, or any occasion for the cautions which were formerly requisite. By this system of managing the bell, it will be seen that all the manoeuvres can be executed quickly, which is a great object, as the operation of clearing an entrance to a ship is in itself so tedious, where only two men can work at once, as to admit no loss of time in the minor operations of descent, &c. The bell, when in the water, will weigh scarcely any thing, and therefore one or two men will be able to manage the bell rope without any purchase or windlass, and will, by simply hauling, have it more readily in command; but as its weight, when it is to be taken out of the water, will be very considerable, they must then apply a strong purchase. To do this with convenience, let the bell rope have a three sheaved block attached to the end of it, a similar block to be lashed to the bell, then revolve as much rope through these blocks as will allow them to be at 15 or 20 feet asunder, and make the fall of this tackle fast to the lower block, so that its end cannot get loose. When the bell is below water, this tackle will be useless, and only suspend the bell, in the same manner as the plain rope would do if it was continued to the bell. It is only used to hoist the bell above water: thus the bell rope is taken up as the bell rises, until it comes near the surface; the upper block of the tackle will then have come up to the yard arm; and it is obvious that it cannot be raised any higher by the bell rope; therefore make the fall of it fast on deck, to afford a suspension for the upper block of the tackle: A few men, by taking hold of the fall, will now have a sufficient purchase to raise the bell up from the water. Of course, in descending, this fall must be given out till its end, which is fast to the lower block, comes tight, and the bell is settled down in the water, before the bell rope is released; by this means the men will never lose time by using the purchase, except when the weight to be raised requires it.

When the divers have so cleared the wreck that they expect to have goods to send up, the tackles for that purpose should be provided. They may very conveniently be suspended from the fore yard-arm of the ship, whilst the bell hangs at the main-yard. There should be a separate crew for this tackle, who take their orders from a person who receives signals from the bell, by means of a guide-line, similar to that of the air barrels. The hook or tongs at the end of the tackle should be connected with this line by a thimble, and then being let down, it will slide to the man in the bell. There should be two or three tackles, that no time may be lost in waiting; and if they are made with blocks in the lower part, as above described, for the bell rope, they will be very convenient for the same reason, viz.
that many of the goods weigh very little in the water, though when they are taken out they require a purchase; for this reason, the boat should attend as soon as they appear at the surface of the water, and make them fast by another sling, because it cannot be expected that the divers in their hurry will be able to sling the goods quite so fast to the rope, as may be sufficient to raise them out of the water, though it has brought them from the bottom.

An apparatus more convenient than the preceding when the bell is to be used in a river or still water, is shewn in Figs. 7, and 8. of Plate CCXXII. The bell is here suspended between two boats of 15 or 20 tons burden each, or they may be such barges as are used on the Thames for transporting coals. These two are well secured together by cross beams, DD, which preserve them at the same distance, and likewise form the base of a wooden frame DEF, lying across the barges, supporting a beam E, from the middle of which hangs a strong block M for the rope, by which the bell H is suspended; the other end of the rope goes round a windlass, a, Fig. 7, with a ratchet wheel and click, to raise and lower the bell H as occasion requires. b, d, Fig. 8, are smaller blocks, for the ropes to draw up the air barrels; e, f, are rollers, turned by winches, which come close together, so that one man can turn them both at once; and when one rope descends, the other ascends, so as to give a constant supply of air to the divers under the bell H. When the divers wish to come up, they give a signal to that effect, and the windlass is turned by men until the bottom of the bell is brought above water. A small boat or raft is rowed under the bell to take the divers out: the same method is to be used to get them in; and this will be done without wetting them, or any other inconvenience. The signals may be given by a line, in the same manner as before described; but as the depth for which such a bell is intended is but small, an air-barrel may be found sufficient; and the air-chamber, or small bell above, will not be necessary. In some cases, the air may be more conveniently supplied by an air-pump and leather pipe, on Mr. Smeaton’s plan, which we shall describe.

An apparatus of this kind would be extremely useful in any large river such as the Thames, where barges are constantly sunk, meurings lost, &c. It would give the means of removing sunken rocks, which, though too deep to be blasted by the usual methods, may be very dangerous to ships, such as the rock in the Thames at Blackwall, upon which several valuable East India ships have at different periods been wrecked. To proceed in such a business, the divers should descend upon the rock, and with a jumper bore a deep hole in the rock in that place where the powder will be likely to have the best effect; in this hole, a tin canister, or glass bottle, containing a proper quantity of gunpowder sealed up and well secured from the water, is to be inserted, and the remainder of the hole filled up in the usual way of miners, with pounded ashes, brick-dust, or sand. To fire off this powder under water, is the only remaining difficulty: This may be done, by having a large tin canister communicating with the former, by a very small tube filled with powder, for priming and leading up to the pan of a common gun lock, contained within the space of the upper canister, and thus defended from the water: A wire from the trigger of the lock is to be conducted through the side of the canister, with proper fittings of leather to make it water tight; and there must also be a wire handle coming through to cock the lock ready for discharging: its fitting should be secured in the same manner. Then tying the end of a small line to the trigger-wire, the diver coils several yards of it upon the rock, cocks the lock, and orders the bell to be drawn up, taking the end of the line with him, but being exceedingly cautious not to pull it till he is above water; and it is to avoid this that the coil of line is laid on the bottom. When all is ready, he draws up the slack of the line, and fires off the powder by snatching the line.

We have heard of gun-powder being fired under water by means of a metal wire leading down to it, and transmitting a strong shock of electricity through the powder to ignite it by the spark. Part of the Aberdovey wreck was broken up by gunpowder to obtain an entrance into her, before the method of cutting her planks and timbers was employed.

The diving-bell appears, at first sight, to be capable of very extensive use to engineers, in constructing the foundations of bridges, piers, sluices, and other works of hydraulic architecture. It would obviate the necessity of coffer-dams to inclose the area of the foundation, and of the engines for drawing out the water, preparations which are generally the occasion of greater labour and expense than the masonry or other work to be performed. Or admitting that the diving apparatus in its present state is not capable of being carried to such a degree of perfection as to construct the whole of new works, there is no doubt it would be very practicable and satisfactory to a surveyor to have the means of examining the state of his work under water, or making trifling repairs, which, from the great difficulty at present of gaining access to the parts, are neglected and deferred until they become of serious extent.

Notwithstanding all these apparent advantages, only two instances have come to our knowledge of the diving bell being efficiently employed by engineers; both were under the management of the late ingenious Mr. Smeaton. His first attempt was to repair the foundations of some of the piers of the bridge over the Tyne, at Hexham, in Northumberland, where the force of the current had excavated the gravel bed of the river, between some of the timber floors on which the piers had been built by the engineer method. He succeeded, by the assistance of his diving-bell, in filling up the cavities beneath the foundations with large rough stones, which were not disturbed by the current, although the evil gained upon the remaining parts of the foundations too fast to be preserved by any method; and on the occasion of a violent flood in the year 1782, the whole structure was carried away in the course of a few minutes after it appeared to be in danger. This diving bell was a square chest of wood, three feet six inches, by two feet at the base, and four feet high; and was supplied with air by means of a pump.

In 1788, Mr Smeaton caused a second diving chest to be made for the purpose of getting up a quantity of large stones, which some years before had been thrown into the sea at Ramsgate harbour, to secure the foundations of the outer pier head. It was in contemplation to build an advanced pier beyond this, and it therefore became necessary to get up these stones; but as many of them were above a ton in weight, the usual method of lugging was not found applicable; whereas by this machine one hundred tons were got up in the course of two months.

Instead of the usual form of bell or of a conical tube of wood, sunk by weights (externally applied) cast iron...
Diving Bell.

This bell was a square chest of cast iron, which weighing
50 cwt. was heavy enough to sink itself, and being 44 feet in height, 41 feet in length, and 3 feet wide, afforded room sufficient for two men at a time to work under it. But it was peculiar to this machine that the men were furnished with a constant influx of fresh air, without any attention on their part, that necessary article being amply supplied by a forcing air-pump in a boat upon the water's surface. Fig. 2. Plate CXXXII. is a plan, and Fig. 3, a section of this chest. The bottom part, AB, is made very thick, to give it sufficient weight, and in the crown are eight round holes, a, a, Fig. 2, each being provided with a lens or glass of four inches diameter, fitted into a brass cell, and then screwed into the cast iron. In the centre is a hole b to receive a brass screw at the end of the leather pipe, which introduces the air. This hole, on the underside, has a leather valve stretched over it, to prevent the return of the air; and the hole has a kind of grating of iron across it, to support the valve against the pressure when it is shut. The valve is nothing more than a square piece of leather stretched over the hole, and fixed to the iron cell by a screw at each corner, not so tight but that it can open to admit the air, though it is always kept in its place; d d are two strong eyes to receive the chains which suspend the bell, and there are similar eyes within the crown to suspend an iron link M, to which chains may be attached. The whole is cast in one piece; e e are two seats for the divers to sit upon as they descend, but these turn upon hinges when they descend and go to work.

The pier, which was afterwards built upon the foundation cleared by this machine, was founded by caissons; but not being done very substantially, or with large stones, the work has in the course of years become so bad, as to require renewal in some places, and in others to be defended by an apron or outside wall of very solid masonry, which has been all laid by the diving bell. This operation is still going on every summer, and the apparatus employed is shewn in elevation by Fig. 1. and a plan at Fig. 5, where AA represents the same cast iron bell, attached by two chains to the three-sheaved block a; another block, b, with three sheaves, is supported between two long timbers DE. These are united to form one frame, as shewn in Fig. 5; and to strengthen them, king posts F, and riders GG, are erected upon them, and very strongly tied to the iron straps, and wooden knees. These beams traverse upon a centre pin d, which is fixed into a very heavy stone; and they are likewise supported by small wheels which run upon a rail-road H, which is curved to a segment of a circle, as shewn in Fig. 5. The extremity E of frame has a heavy stone attached to it, to balance the weight of the bell appended from the opposite end. The fall of the tackle is conducted through a block x, to a capstan, by which it is taken up or let down. This machine is placed upon the top of the pier wall IK, Fig. 1, at the foot of which the stones dotted at LM are to be laid by the divers. The different motions are thus given to the bell: to bring it nearer or farther from the wall, the block b is moved in the beams, and for this purpose it is made to slide freely between them; to haul it in, a pair of blocks e, f, are used, and it is drawn out by a rope passing through a block at D, and then to the pair of blocks g, h, Fig. 5; to move it sidewise, two pair of tackles are applied at i, k and l, m; R is the leather pipe conducted from the bell to the forcing pump N, which is fixed on board the boat, Fig. 4, and is worked by the lever handle n; w is a rope extended from the bell to the boat, and being shorter than the pipe, it prevents it from being broken or stretched by the wind or tide carrying the boat away; and it is also secured to the pier by the rope p. The man at the pump N is directed to force down so much air to the bell as will cause the air to flow out beneath the lower edge of the bell, and rise in bubbles to the surface; and as long as this continues, he knows that the divers are well supplied with air. As the depth in which this machine is used is very small, the signals are not made by a line, but by the divers striking with a hammer upon the inside of the cast iron of the bell: This produces a peculiar sound, which can be heard very plainly above, and is not liable to be mistaken for any other noise: the number of blows denotes what they wish, according to the following table, which is painted withinside the bell, and the people above have a duplicate of it.

1. More air. 5. To eastward.
2. Stand fast. 6. To westward.
3. Heave up. 7. From the wall.
4. Lower down.

The manner of proceeding is this: The stones are all prepared, and jointed together with dovetails, before they begin to lay them; and the first thing to be done is, to make the foundation perfectly level and true. The loose sand, &c. is removed, by dredging from above in the usual manner; and then the bell, with two men in it, is let down to the bottom, which, at Ramsgate, is a hard chalk rock; when it stands thereon, it lays the chalk dry to the level of the bottom edge of the bell; but if the surface is uneven, the bell cannot descend so low but that it will leave 6 or 8 inches of water on the bottom. The surface of this water is the level they work to, and by cutting away every eminence which rises above the water, they soon obtain a perfect level surface. They work with a small pick, made something like a narrow adze, for this purpose; and the work proceeds rapidly, for the chalk is not very hard. When they have accumulated as much rubbish as becomes inconvenient, they give three knocks on the bell to order the people to draw it up, till they, standing on the bottom, find themselves knee deep; then two knocks to stand fast. They now take in a shallow basket which has been previously let down from above, and fill the rubbish into it; then snatch it to order it to be drawn up, and strike four times on the bell that they may be lowered down to proceed with their work. Having in this manner heaved away the surface till the water standing equally all over it, shews it to be a perfect level plane, they give orders to be removed to a new situation, yet at such a small distance that part of the surface they have been levelled, is still beneath the bell, in order that both may be brought to one plane. Thus continuing the work, they get all the rock prepared for the stone work, without any other level than the water. To hoist the stones which are to be laid, they use a crane, of which the reader will find a description and figure under our article Crane. It moves on wheels, and can therefore be wheeled upon the pier to the required spot, close to the diving machine. The first stone is taken up by it out of the boat, the hooks of the crane being put in the ring of a lewis, which is an iron wedge, so fitted into a hole in the stone, that it will not draw out by the weight of the stone, though the mason can relieve it in a moment. The stone is turned round into the position in which it is to be laid, and lowered to the bottom as close as is convenient to the
DIVISIBILITY OF MATTER. See Physics.


DIVORCE, is a judicial separation between man and wife, more or less complete, variously affecting the conditions of the marriage-contract, and allowed for different reasons, and to each, or only one of the spouses, according to the respective municipal institutions of different countries.

In ancient Greece and Rome, and perhaps in all pagan countries, the marriage bond was entirely broken, leaving the parties at liberty to form other matrimonial alliances, as if no previous marriage had ever existed. At Athens, and in the later period of the Roman republic, the right of divorce was equally exercised by both sexes, although, in the earlier ages of Rome, it belonged exclusively to the men. In both countries, too, it was permitted on a variety of grounds, such as adultery on the part of the wife, imposing supposititious children on her husband, counterfeiting his private keys, &c. desertion on the part of the husband, unnatural severity towards his wife; and, on either part, sterility, old age, or other infirmities; till at last, the most frivolous reasons, and even mutual consent, were regarded as sufficiently competent grounds for thus totally dissolving the matrimonial connection. The effects upon the conditions of the contract, in other respects, were various, according to circumstances. The most important were, that, where the divorce had taken place, in consequence of the wife's infidelity, she forfeited her dowry; when without any fault on her part, she reclaimed it, and was also allowed to retain the presents which had been made her by her husband.

The introduction of Christianity created a great change in most countries of Europe, on this particular of their municipal institutions. Marriage, which, from its intimate connection, not only with the happiness of the married parties themselves, and of their offspring, but also with the general welfare of the community, is, even in rude and early stages of society, frequently found blended with the ceremonies and sanctions of religion, came now to be regarded as much in a spiritual as in a civil light. The Romanists exalted it to the rank of a sacrament; and, reasoning from the text of scripture, which says, "whom God hath joined together let no man put asunder," their canonists maintained, that divorce, in the sense of the heathen world, was altogether impious and impossible.

According to the Roman institutions, therefore, there is no such thing as divorce, properly so called. They admit not of a total dissolution of the nuptial bond for any cause whatever; so that if a party be once truly joined, neither the death of one of the spouses can put the other in a condition to form a new alliance. At the same time, they admit certain causes, such as severe treatment of the wife, adultery by either of
the spouses, intolerable temper, as sufficient to authorize a partial separation, or a *mensa et thoro*, by which the cannabial society is broken up, while the marriage itself continues to subsist. It must also be observed, that if certain impediments existed *at the time* the marriage was entered into, and not afterwards supervening, such as nonage, corporal imbecility, and many others, the marriage is, by the Roman institutions, capable of being totally annulled. But as in the former case there is properly no divorce, the marriage still subsisting to many important effects; so neither in this can the term, at least in its ancient signification, be applied, there being strictly no dissolution of a marriage, but rather a declaration that, *ab initio*, there was none, by reason of the impediments that had all along existed in bar of it.

As most of the countries of Europe fell under the influence of the Roman church, this came, of course, to be the prevailing notion regarding divorce; and, even when the Protestant countries had asserted their spiritual independence, views of sound policy induced many of them to entertain the same ideas regarding the indissolubility of the nuptial yoke, which their religious instructors had formerly imposed.

In England, in particular, the law of divorce continues to this day, precisely as regulated by the Roman canonists. No divorce, properly so called, can be obtained, for any reason whatever. A special enactment by the whole legislature is necessary for each particular case. Nor have even the legislature been hitherto induced to interfere, but in the case of the highest injury suffered by one of the spouses—infidelity to the marriage bed, which must have previously been the subject of a regular suit and conviction in the competent court of law. In case of *divorce a mensa et thoro*, (for the law of England applies the term to that partial separation of the married pair,) alimony, or the means of subsistence, is allowed to the wife out of the husband's estate; and it is adjusted by the judge according to the circumstances of the case and of the parties. If the divorce, however, has been obtained by the husband against the wife, on the ground of adultery, and she continues to live with her paramour, the law denies her any support out of her husband's means.

By the law of Scotland, besides a separation *a mensa et thoro* merely, divorce properly so called is authorised. The grounds upon which it may be sought are specified to two—adultery by either of the spouses, and desertion for the period of at least four years. These are the reasons which the Scottish reformers, disdaining to be trammelled by the Roman institutions, founded warranted by Scripture, *Matth. v. 32; 1 Cor. vii. 5.* In this action the commissioners of Edinburgh are the only competent judges in the first instance; and before they can proceed to consider the grounds of the action, the pursuer must make oath that it is in no respect collusive. The marriage bond is entirely broken by the judicial sentence, there being no limitation upon the parties from forming any new connection, except that by express statute, 1600 c. 20, if the divorce has been obtained on the head of adultery, the offending parties are prohibited from intermarrying; a wise regulation, since otherwise the crime might often be committed in the very view of accomplishing such a marriage. In the case of desertion, the absence must be wilful and malicious, and the party deserting must first be ordered by the judge ordinary to adhere. On default, denunciation, as it is called, must follow, and afterwards excommunication by the church. The commissioners may then proceed to give forth their sentence of divorce. If the wife has been the offender, either in the case of infidelity or desertion, she forfeits her *tocher* (or dowry,) to the injured husband, together with all the provisions which would have accrued to her upon her husband's decease, whether these have been fixed by contract between the parties at entering into the marriage, or have been left to the general disposition of law. If, on the other hand, it is by the husband's desertion that the divorce has been occasioned, he both restores the tocher, and makes good the provisions in favour of the wife, to which he is bound either voluntarily or by law. But it has been decided, that where the divorce proceeded on the ground of the husband's adultery, he is not liable to restore the dowry, but only to make good the wife's legal or conventional provisions.

Of late, our neighbours in England have manifested some disposition to avail themselves of the facilities afforded by the Scottish institutions for obtaining divorces; and certain individuals, passing the border, and obtaining a domicile in Scotland, have contrived accordingly to accomplish their purpose—an indication not inconsiderable of the increasing dissoluteness of manners among that people. To what extent the courts of England may be disposed to countenance the proceeding is not yet ascertained. That it is, however, a matter of high concernment to the national policy, is sufficiently obvious; while, at the same time, it furnishes a very curious and difficult subject of speculation as connected with that courtesy which the judicial establishments of one country ought, as much as possible, to practise towards those of another. It forms, however, only one instance of the general doctrine of this courtesy of nations, or, as it is termed among professional men, the *comitas gentium*. We therefore avoid entering upon it at present, as a fit opportunity will occur under the article *Law*, for discussing together the whole principles of this nice and delicate subject. *(i. n.)*

**DIURIS**, a genus of plants of the class Gynandria, and order Diandria. See *Botany*, p. 344.

**DIXAN**, a town of Abyssinia, is situated on the summit of a conical hill, and is encircled with a deep valley like a trench. The hill commands an extensive prospect of the mountains of Tigré, and the country around, which consists chiefly of rocky mountains, many of which have villages like Dixan. The road to the town is a spiral ascent, which has a fine effect. The houses are flat roofed, and have no windows. Instead of chimneys, they have two very narrow earthenware pots, rising out of the roof. The only public building here is the chapel, which consists of mud walls, and a conical thatched roof. When Mr. Salt entered the door of the enclosure, the boys who conducted him kissed the door posts. The inner building was shut, and the surrounding circle, which was strewed with rushes, had its walls covered with various strange figures in glaring colours, among which were St. George and St. Haimonout on horseback, with spears. The inhabitants bring their water from a valley about a mile from the town. The best articles for barter here, are tobacco, black pepper, looking-glasses, snuff, spirits, and large green beads. White cloths are preferred by the people to those of any other colour.

The town is inhabited by Moors and Christians. Every man has from one to ten wives, according to his wealth. Boys marry at 14 years of age, and girls at 10, 11, and 12; and the children are circumcised by the women when they are eight days old. All the
DIXMUDE, DIXMUDE, DIXMUD, DIXSMUTZ, a town of France, in the department of the Lys, is situated in a fertile plain on the river Yperle. It had formerly four convents, and is celebrated for the excellent quality of its butter and cheese, which is obtained principally from the territory of Furnes. It was once a strong place. A fair is held here on the third Sunday of July, which lasts eight days, and at which are sold cattle and various articles of merchandise. Population 2521. Distance from Dunkirk 24 miles east, and from Furnes and Nieuport nine miles north. (J)

DIZIER, St. Sacre, Desiderii, Fanum, is a town of France, in the department of the Upper Marne. It is situated on the right bank of the Marne, at the place where this river becomes navigable. The fortifications of this place have been greatly neglected. The road between Vitry and St. Dizier is reckoned the finest in Europe. Between this town and Joinville, there was discovered, in 1772, the ruins of a Roman station about 2900 feet long, and 1800 feet wide. There are several iron mines and forges in the neighbourhood, and the principal manufactures are cast iron, linen cloth, hosiery, hats, and leather. It carries on also a very considerable trade in wood, particularly in that which is used in the construction of ships; the depot is at St. Dizier, where it is embarked on the Marne, and conducted to Paris. A great number of boats are built here, and a considerable trade is carried on in corn and iron. Population 5834. (m)

DNIETER, NIEPER, DAXAPIS, the Borysthenes of the ancients, is one of the largest rivers in Europe, and the chief river of all the provinces adjacent to the Euxine. It rises in the government of Smolensk, near the same place as the Volga and the Southern Dvina; and after running southwards through Lithuania, the country of the Zaparog Cossacks, and that of the Na-gay Tatars, it discharges itself into the Euxine or Black Sea, at Kiburn, near Oezakof. The Dnieper is navigable from Smolensk, if not from Dorogobush; but its navigation is badly obstructed by numerous flats or moving sands, common to all the rivers in the north of Russia, and by numerous cataracts. From Kiof, downstream, the navigation is greatly recommended by the flats in the middle of summer. Channels of considerable depth exist near the shore on both sides, but these are constantly shifting during the floods; and the only method of remedying this evil is to have pilots stationed at particular places to sound the river, and direct the vessels into the right channels. This has already been done with great effect in the river Svir.

The cataracts of the Dnieper, formed by huge blocks of granite projecting into the river, are a still more formidable obstacle to its navigation, as the banks can get over them only at high water during the spring. During the government of Potemkin, an attempt was made to clear the cataracts, but the work was stopped by the war in 1767. Since the commencement of the present century, the attention of the emperor has been strongly directed to this subject. The Board of Inland Navigation has begun to deepen a channel between the cataracts, by means of temporary dikes through which the banks may pass both up and down the river in the very middle of summer. This plan, however, is far from being quite inapplicable to the great Neussandez cataract, they began to dig through a rocky shore at a circuitous canal round it, provided with sluices. The clearing of other three cataracts were begun, and eight remained to be executed. These works were going on slowly in 1805 when Mr. R. Corner visited that country; and he informs us, that a float of timber, which arrived while he was at Odessa, had spent two years in coming down, from the impediments of the cataracts. Below the cataracts, the Dnieper resembles the Volga, and is intersected with many islands and flats. The current, which is not strong, admits of the use of oars for vessels going up, and of sails when there is very little wind. The marshy nature of the shores has rendered it necessary, in some districts, to establish towing paths, which will be of the greatest service in accelerating the return of barks with salt, silk, cotton, and the other products of the Levant, which are absolutely necessary for the inland manufactories. The lemon or estuary of the Dnieper, is extremely hostile to the export trade. It flows slowly into the Euxine, through several branches, and forms numerous sand banks; so that in summer, when there is scarcely six feet of water, merchant vessels are obliged to land 35 versets beyond its mouth, at the Gubolitaya pristan, or deep wharf. Even this place is very unfit for the purpose, as the road is sometimes un navigable from November to May; and when the dock-yard was at Cherson, it became necessary to use canoes for transporting the men of war over the sand flats in the estuary. From these causes, Nicolae, situated on the Bog, and the Ingul, was chosen for the seat of the admiralty; but being found inconvenient for trade, on account of its distance from the Dnieper, the port of Odessa was constructed on the bay of Had-giby, which was particularly eligible on account of its vicinity to Poland, Podolia, and Volhynia. Maga- zines and storehouses have been erected for the goods brought down the Dnieper, and also along the banks of the Dniester, for the products of Galicia and Podolia.

About 300 vessels descend the Dnieper to Nicoloaf and Cherson, and vast floats of timber are brought down for the admiralty. About 60 boats laden with salt ascend the Dnieper from Kremenchuk to Smoles-insk, and also several of its branches, to the wharfs of Novgorod, Severskoy, Pinsk, and Borovitz. This salt is conveyed by means of oxen from the Crimea to Kremenchuk; but when the cataracts are cleared, the land carriage will be diminished to 1300 versets from a circuitous canal, from the Crimea to the wharf of Berezasskoy on the Dnieper, and the salt may be carried by water from the salt pits of Kiburn.

Many of the streams which fall into the Dnieper are navigable, or capable of being made so, excepting in seasons when the parent river is itself unfit for navigation. The principal of these are the Drusa, which is small and unnavigable, joining the Dnieper at Rogatchef; the Beresina, a pretty considerable river, by which masts are floated down to Borisof, and even to the wharf of Pedoezerskoy; the Sosha, which is navigable in July for 500 versets, and supplies Kiof with timber; the Pripit, which is the chief branch of the Dnieper, separating Lithuania from Volhynia, and carrying down great
quantities of timber; the Teterova, capable of being made navigable down to Ortomis; the Desna, which runs through the most fertile and best wooded districts, and is navigated for 800 vers from Tchernogof, Novogorod, and Severskoy to Bransk, by from one to 300 barks annually, while a greater number returns to it with salt; the Soluta, which is navigable from Luben; the Peisof, which flows through a steppe, and is navigable in spring; the Torfska, which could be made navigable to Akia in the Ukraine; the Samara, which will soon be employed in conveying to the Dnieper the newly discovered coal near Paflograd; the Inguletz, a considerable river of the Steppé; and the Bog, or Bugg, which falls into the estuary of the Dnieper, about 30 vers above Oczakof, and is one of the chief rivers in the country, admitting ships of war 150 vers from its mouth. See Tooke's View of the Russian Empire; and particularly Clarke's Travels, vol. i. 2d edition, p. 768. (x)

DNIESTER or NESTER, a river which separates the dominions of Russia from those of the Ottoman empire. It passes by Halics, Choczim, Saroka, Ras-cow, Egerlik, Bender, &c. and discharges itself into the Black Sea at Akerman. It is a river of very considerable magnitude, and is navigable for vessels of a moderate size. It is in general deep, and even in seasons of drought may be navigated by vessels not drawing above two feet of water. There are many shallows, however, in the upper part of the river, which in summer have not above 2½ feet of water. The cataract over a granite ridge at Yampole, which formerly obstructed the river, is now cleared away, and the establishment of towing paths has been in contemplation by the Russian government since the peace of 1791, and is probably already completed.

The Dniester forms, at its embouchure, a shallow leman or gulf, which will not admit vessels that draw more than five feet of water. It is three vers long, and about five broad, and joins the sea by two different branches. A Russian flotilla, however, during the last war, went up to the very walls of Bender. A considerable trade is carried on from Odipiopolis to Akerman. On the upper part of the Dniester are four principal wharfs, viz. Stria and Salezic in Austria; and Svanetz and Dubozar in Podolia. The Lemen of the Dniester abounds in fish, particularly in sterlet and sturgeon.

The tributary streams are the Kuzorgan, a torrent which is dry in summer, and falls into a fresh water lake of the same name joining the Dniester; the Botua, which rises in Bessarabia, and is a small and marshy stream; the Komorofka, a torrent of the Steppé; the Yashlik, Chemaya, and Tamanishik, which are mere torrents, and the Yarleka, which has a great deal of water, and a stony bottom, and runs so near the Bog, that it was once proposed to unite the last with the Dniester. The Dniester separates into two branches, one of which keeps its name, and the other is called Stric. The first branch is navigable as far as Sambor, and the second to Stric. The Peloças, a small stream, runs into the Dniester at Samorod, by means of which, the Austrians intended to join this river with the Vilia. See Clarke's Travels, 2d edit. vol. i. p. 779. (x)

DOBBERAN, a town of Germany, in the Duchy of Mecklenburg, and kingdom of Saxony, is situated about two miles south of the Baltic. It was formerly celebrated for its monastery, which was founded in 1170; but it is now famous as a watering-place, which is much frequented by the first families in the north of Germany. The baths, which possess every kind of accommodation, are delightfully situated in a wood upon the Baltic, about two miles from the town. There is a warm bath, and nine cold baths, besides several bathing machines, and accommodation for invalids who are unable to walk or ride to the shore. There are two excellent hotels in the town, and a number of elegant and commodious lodging houses. A full account of this watering place, and of the various amusements which are provided for the company, will be found in Reeper's Geschichte und Anekdoten von Dobberan, nebst Beschreibung der dortigen Seebad.—Anzahlen. New-Strietiz, 1801, 8vo. See also Reichard’s Guides des Voyageurs en Europe, tom. ii. 4mo edit. p. 202. (j)

DOCKS. See NBOUR.

DODARTIA, a genus of plants of the class Dildynia, and order Angiosperma. See Botany, p. 254.

DODDRIDGE, Philip, an eminent tutor and divine among the Protestant dissenters, was descended of an ancient and respectable family, which appears to have been originally settled in Devonshire. His father, Daniel Doddridge, traded as an oilman in the city of London, and was heir-at-law to a considerable estate of about £2000 a year, but was deterred from prosecuting for its recovery by an apprehension of the hazard and expense. His mother was the only child of the Rev. John Bauman of Prague, whose adherence to the Protestant religion induced him, in 1625, to leave his native country, and a considerable estate; and who, after his arrival in England, was elected master of the free-school at Kingston-upon-Thames. Dr Doddridge was born at London on the 26th day of June 1702, and was the last of twenty children, who all died young, except himself and one sister. At his birth, he was so utterly destitute of every sign of life, that he was thrown aside as dead; but one of the attendants having observed some appearance of breathing, his existence was, with great care, providentially preserved for the benefit of mankind. From his infancy, however, he possessed an infirm constitution and consumptive habit, which rendered both himself and his friends apprehensive that his life would be short. He was trained up by his parents in the early knowledge of religion; and before he could read, was instructed by his mother in the history of the Old and New Testament, by the aid of some painted Dutch tiles in the chimney, while she accompanied her explanations with such suitable reflections, as made a lasting impression upon his mind. At ten years of age he was sent to the school at Kingston-upon-Thames, which had been taught by his grandfather Bauman, where he continued till the year 1715, equally distinguished by his pious disposition, and his application to learning. At this period, he was left an orphan by the death of his father; and at the same time, by the misconduct of the person who had been entrusted with the management of his pecuniary affairs, he lost the whole of his private fortune. But having been removed, at the time of his father's death, to a private school at St Albans, he happily formed an acquaintance with Dr Samuel Clark, describing minister of the place, who, continuing, through life, to treat him with all the kindness of a parent, and by whose generous assistance he was enabled to proceed with his future studies. During his residence at St Albans he began to keep a diary of his life, which affords ample testimony of the diligence with which he improved his time, and of his anxiety to be daily advancing in knowledge, piety, and usefulness. In the year 1718, he withdrew from school.
to the house of his sister, who had married Mr. John Nettleton, a dissenting minister at Ongar in Essex; and there employed himself in seriously deliberating upon his future profession. He was strongly inclined to the office of the ministry; but the narrowness of his circumstances presented little prospect of his wishes being accomplished. The Duchess of Bedford, who entertained a regard for his family, offered to support the expenses of his education at either of the universities, and afterwards to provide for him in the church of England; but, as he could not conscientiously comply with the terms of conformity, he declined the proposal with the utmost gratitude and respect. Others among his friends advised him to pursue the study of the law, and every favourable offers were made to him by a gentleman of that profession; but while he was deliberating upon the subject with devout applications for divine direction, he received a letter from Dr. Clerk, proposing to take him under his care if he chose the ministry upon Christian principles. Thankfully embracing this offer, he returned to the house of his friend at St. Albans, where he was furnished with books and directions in his studies; and, in October 1719, was placed under the tuition of the Rev. John Jennings, in the Academy at Kibworth, in Leicestershire. Under the direction of this gentleman, he prosecuted his studies with uncommon diligence; and besides perusing with close attention the most valuable theological works, he greatly increased his acquaintance with classical literature, especially with the Greek writers, upon many of which he wrote observations to a considerable extent. Nor was he, at this time, attentive merely to the acquisition of useful and ornamental knowledge; but was equally ardent in the cultivation of personal religion, as appears from the rules which he drew up for the regulation of his temper and conduct. In 1722, having been previously examined by a committee of ministers, and having received an ample testimonial of his qualifications, he preached his first sermon at Hinckley, whither Mr. Jennings had removed. After continuing to pursue his studies another year, he received, much about the same time, an invitation from a small dissenting congregation at Kibworth, and an application from the city of Coventry to be assistant to Mr. Warren; but preferred the former situation, partly on account of his youth, and also of the opportunity which the retirement of an obscure village afforded for the farther acquisition of knowledge. It was during his residence at this place, from June 1723 to October 1725, that he more especially excelled as a preacher. He was remarkably careful in his preparations for the pulpit, drawing up both his sermons and expositions with great exactness of method, and expressing his sentiments in language at once correct and elegant, and yet plain and easily understood. He was also regularly employed in the serious perusal of writers on practical divinity; and among these his favourite authors were Tillotson, Baxter, and Howe. Nor amidst his more serious pursuits did he discontinue his attention to polite literature; but frequently read the more elegant writers of the French nation. He particularly admired Fenelon and Racine; and among their sermon-writers, whom, however, he did not generally esteem, he gave the preference to Superville and Saurin. While thus solicitous to enrich his mind with various acquirements, he was duly attentive to the private duties of his station; and equally careful to adapt himself in conversation to the capacities of the humble people under his care. From the time that he entered upon the ministerial office, he received several invitations to more numerous congregations than his first settlement, particularly to a large society of dissenters in London, and to two similar associations in Nottingham; but after mature deliberation, he adhered to his plan of prosecuting his own improvement in a more retired residence. In 1729, he was chosen assistant to Mr. Some at Market-Harborough, where he had chiefly resided during the four preceding years; but he still continued to preach alternately to his people at Kibworth. Mr. Jennings considering Mr. Doddridge as the most likely of all his pupils to carry on and complete the plan which he had formed for conducting a theological academy, had earnestly advised him, but without mentioning his motive, to keep in view the improvement of the course of lectures which he had attended. Agreeably to this advice, he had carefully reviewed the compendium which he had made of these lectures; and having had occasion to draw up, at the request of a friend, a plan of conducting the studies of young men intended for the ministry, his own qualifications for the office of a tutor became more generally known. His plan had been shown to Dr. Watts, who not only expressed his approbation, but concurred with many others in the opinion, that the person who had devised was the best qualified to execute the scheme; and the matter having been proposed by Mr. Some to a meeting of dissenting ministers at Lutterworth, Mr. Doddridge was unanimously solicited to undertake the office of a theological tutor. After much hesitation, and with the utmost diffidence, he at length gave his consent; and having availed himself of all the information which he could derive from the best treatises on the education of youth, and the communications of his numerous friends, he opened his academy at Market-Harborough in the summer of 1729; but had scarcely continued a few months in this employment, when he was invited to undertake the pastoral charge of a congregation at Northampton. To this place he removed at the close of the same year; and for the space of twenty-one years, continued faithfully to discharge the duties of his pastoral office, and to conduct the business of his theological academy. At first, after his removal to Northampton, the number of students under his care was very limited; but gradually increased every year, so as to render it necessary for him to employ a stated assistant to superintend the junior pupils. During the 22 years that he exercised the office of a tutor, about 200 young men were placed under his care; and of that number 120 afterwards entered upon the ministry. In 1730, he married Mrs. Mercy Marias, a native of Worcester, who possessed every qualification that could minister to his happiness, and to whom he uniformly testified the greatest tenderness and affection. From his settlement at Northampton in 1729, to the commencement of his last illness in 1750, he produced a succession of the most valuable works, of which an account will afterwards be given, and which have proved instrumental of the highest benefit to the best interests of the human race. By these fruits of his pen, his name became more extensively famous. And in 1736, the colleges of Aberdeen united in conferring upon him the title of Doctor in Divinity. Upon this occasion his pupils testified their respect by offering their congratulations in a body; but he said to them in reply, "that their learning, piety, and zeal, would be more to his honour, and give him a thousand times more pleasure, than his degree, or any other token of
public esteem." The incessant application, which these various labours required, often excited the apprehensions of his friends; and at length impaired his naturally delicate frame to such a degree, that it was unable to stand the attack of disease. In December 1750, he went to St Albans to preach the funeral sermon of his venerable benefactor Dr Clerk; and in the course of his journey, he contracted a cold which brought on a fatal pulmonary complaint. As long as he apprehended no immediate danger, he could not be induced, by all the remonstrances of his friends and physicians, to decline the various sacred employments in which he so much delighted; and he was particularly anxious to complete the transcript of his Family Expositor. He was at length obliged to desist from his labours, and withdrew to the house of his friend Mr Orton at Shrewsbury, where he seemed to be a little recruited by the retirement which he enjoyed. In the autumn of 1751, he was advised by his medical attendants to make trial of the Bristol waters; but the physicians of the place gave him little hope of deriving much benefit from their use; and it was recommended to him as the last resort, to pass the winter in a warmer climate. By the generosity of his friends he was enabled to proceed to Lisbon, and was provided with every possible advantage and accommodation. But soon after his arrival, the rainy season came on with such uncommon violence as precluded all benefit from air or exercise, and greatly aggravated his complaints. On the 24th of October, he was seized with a colliquative diarrhoea, which speedily exhausted his remaining strength; but he still preserved the same composure, vigour, and cheerfulness of mind, which he had uniformly possessed throughout the whole period of his distress. He desired the most affectionate remembrances to be conveyed to his children, his congregation, and his friends in general; and expressed a variety of devout sentiments, which Mrs Doddridge was too much affected to recollect with sufficient distinctness. On the day preceding his death, he lay in a gentle slumber, and at last, having appeared somewhat restless during the space of an hour, he died on the morning of the 26th of October, 1751. Agreeably to his own desire, his body was opened after his death; and his lungs were found in so extensive a state, as to render it surprising that his speaking and breathing had not been more painful to him than they were even to the last. His remains were interred in the burying-ground of the British Factory at Lisbon; and a handsome monument was erected to his memory by his congregation in his meeting-house at Northampton. He left behind him four children, three daughters, and one son named Philip, who was bred to the law, and settled as an attorney at Tewksbury.

Dr Doddridge was not handsome in his person, which was very thin and slender, rather above the middle size, and stooping considerably from the shoulders; but when he was engaged in conversation or in preaching, there was a remarkable sprightliness and vivacity in his countenance and manner. He possessed what are rarely united in one person, great quickness of apprehension, a remarkable strength of memory, and an uncommon application in the prosecution of his studies. He was surpassed by few in the extent of his learning, and the variety of useful knowledge which he had acquired. Though he could not be called a profound linguist, he was sufficiently versed in the learned languages to read with pleasure the most valuable productions of antiquity; and though his disposition inclined him to polite literature, rather than to the more abstruse sciences, he was far from being a stranger to mathematical and philosophical studies. But it was to divinity, in the largest sense of the word, comprehending all the subjects of natural and revealed religion, the evidences of the Jewish and Christian revelations, ecclesiastical history, the writings of the fathers of the three first centuries, and the different systems of theology, that he chiefly applied his mind, and that he attained the highest excellence. The stores of information which he had collected, were well arranged in his mind; his own ideas of the parts which he had studied were clear and distinct; and he possessed an uncommon facility both in speaking and writing upon the subjects with which he was acquainted. Hence, as a preacher, he was often able, when in the full flow of spirits, to speak with little preparation, and with great elocution and effect; and when he employed greater care in the composition of his sermons, his method was perspicuous, and his sentiments naturally arranged. He studied at least to conclude his discourses with an animated and affectation application; and his mode of delivery, like his ordinary style of conversation, was full of vehemence and vivacity. In his younger years particularly he gave proofs of considerable poetic powers; of which his celebrated paraphrase on his family motto, "Dum vivimus vivamus," which Dr Johnson has specified as one of the finest epigrams in the English language, may be given as a specimen:

"Live, while you live," the epicure would say,
"And seize the pleasures of the present day."
"Live, while you live," the sacred preacher cries,
"And give to God each moment as it flies."

Lord, in my views let both united be;
I live in pleasure, while I live to thee.

Of his moral and religious character, it is scarcely possible to speak in too high terms; and it may almost be affirmed of him in his own words, "that it is hard to say where, but in the book of God, he found his example, or where he has left his equal." His piety was ardent, uniform, and unaffected; and was particularly displayed in the resignation, serenity, and cheerfulness with which he sustained his afflictions. The nearer that his dissolution approached, his impiurnental spirit was the more remarkably conspicuous; till at length he seemed to have completely risen above the concerns of this world, and to be daily breathing after immortality. This devout disposition was accompanied by the warmest benevolence to his fellow creatures, which was abundantly manifested in the most active exertions for their welfare, in his tendency to overrate the merits of others, in his candour and moderation towards those who differed from him in sentiment, and in the mild and forgiving temper with which he bore the most unkind and unmerited treatment. He was distinguished by the humility with which he regarded his own attainments, the condescension which he shewed to the meanest persons, and the patience with which he submitted to the words of reproof. In the private virtues of friendship and domestic life, he was remarkably amiable; and his deportment in company was strikingly polite, affable, and pleasing. He has sometimes been blamed for the accommodating style of his language in addressing persons of different sentiments, the over complimentary strain of his epistles, the fondness which he shewed for universal applause, and the ostentation with which he sometimes spoke of the multiplicity of his engagements; but notwithstanding these slight imperfections, (and they are all that
DODDRIDGE was ever laid to his charge,) he must be acknowledged, in the words of Dr Kippis, to have been "not only a great man, but one of the most excellent and useful Christians and Christian ministers, that ever lived."

Besides carrying on, during his life, a most extensive correspondence, sufficient to have occupied the whole of most proposers, and publishing a number of occasional sermons and smaller pieces, which, under the title of "Tracts," form three volumes 12mo, Dr Doddridge, by his strict economy of time, found means, amidst his abundant labours as a tutor and a pastor, to produce, as an author, a number of works, which have been very highly and generally esteemed. In 1732, he published Sermons on the Education of Children, which contain, within a small space, many important considerations for the encouragement of parents in this momentous duty; and in 1733, seven Sermons to Young People, which have been equally well received. In 1736, appeared his Ten Sermons on the power and grace of Christ, and the evidences of his glorious Gospel; the three last of which were afterwards printed separately, and were successful, among other instances, in convincing the minds of two gentlemen of liberal education, who had been sceptical on that subject. In 1739, he presented to the public the first volume of The Family Expositor, which may be considered as his great work, and the dedication of which, to the Princess of Wales, has been pointed out as furnishing one of the best specimens of his talent for elegant composition. In 1740, appeared the second volume of the same work; and in 1741, a course of Practical Discourses on Regeneration, which have been justly characterized by a foreign divine as uniting orthodoxy with moderation, zeal with meekness, and deep-hidden wisdom with uncommon clearness; as displaying simplicity without coldness, elegance without painting, and sublimity without bombast. In 1745, was published one of his most popular and useful works, The Rise and Progress of Religion in the Soul, which was written at the request of Dr Isaac Watts, and which, besides obtaining the high commendations of many eminent established clergymen, and an extensive circulation in this country and America, was translated into the Dutch, Danish, French, and German languages. In 1747, he published Some remarkable Passages in the Life of the Hon. Col. James Gardiner, a work of which many of his literary friends, and the learned Warburton in particular, expressed the most unqualified approbation. In 1748, appeared the third volume of The Family Expositor; and in the course of the same year, he revised the expository works and other remains of Archbishop Leighton, and translated his Latin Prayers, an employment in which he declared that he experienced the highest edification and delight. Of The Family Expositor three volumes remained to be published after the death of the author, but the whole had been finished in short hand, excepting a few notes at the conclusion; and the greater part, especially the whole of the fourth volume, which was published in 1754, had been actually transcribed for the press. In 1755, Mr Orton published a volume of hymns from the pen of Dr Doddridge, which have been generally acceptable, and have passed through numerous editions. In 1756, the same gentleman published the fifth and sixth volumes of the Expositor; and thus completed a work on which the author had bestowed the greatest care, and on which his literary reputation chiefly depends; a work which continues to be held in the highest estimation, and which has eminently contributed to the instruction and improvement of the Christian world. The last work of Dr Doddridge, given to the public, was his Course of Lectures on the principal Subjects of Physic, Ethics, and Divinity; with References to the most considerable Authors on each Subject; and was published in 1763 by the Rev. Samuel Clerk of Birmingham, the son of the author's earliest benefactor. Another edition, improved by new and appropriated references, was published in 1794, in two volumes octavo, by Dr Kippis. Upon this work, which was formed upon the plan of Mr Jennings, Dr Doddridge employed much of his time; and, to the last moment of his life, he continued to enrich it with additional remarks. See Biog. Britannica; Orton's Life of Dr Doddridge; and Letters to and from the Rev. P. Doddridge. (q)

DODECAS, a genus of plants of the class Dodecandra, and order Monogynia. See Botany, p. 223.

DODECATHEON, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 136.

DODONA. See Oracle.

DODONÆA, a genus of plants of the class Octandria, and order Monogynia. See Botany, p. 204.

DOFAR, or DAFAR, is a seaport town of Arabia Felix in the province of Hadramaut. It is called Hamme Badgerey by the natives, and is situated about 50 leagues from Cape Fortash. The town is small, and the anchorage is about two miles from the shore. Dofar was formerly a place of importance, but was destroyed by the Portuguese in 1526. The principal article exported from Dofar is incense, called olban, or liber, but it is greatly inferior in quality and virtue to that of India. Provisions and refreshments cannot be procured here. The natives, who are shy, though not unfriendly to strangers, are armed with matchlocks and spears. East Long. 54° 33', North Lat. 17°. (r)

DOG. Among the various animals which have been rendered subservient to the human race, the dog ranks high in utility and importance. Recurring to the earliest stages of society, we find that, by means of its fleetness, courage, and sagacity, creatures the most ferocious were subdued or obtained for domestication; that it has ever contributed to procure subsistence for man, to watch his personal safety, and to protect his property. If we are not now equally sensible of the advantages resulting from its aid, it is because other substitutes have rendered it less essential.

The dog belongs to the genus canis of Linneaus; but at this day the species are so much multiplied, and so diversified in colour, size, and appearance; the gradations so slight and innumerable, that it is difficult, if not totally impracticable, to confound on those possessing exclusive characteristics. Neither should we find it an easier task to ascertain the primitive stock from which one or more of the races has sprung; for although celebrated naturalists have entered on this inquiry, their results are vague and unsatisfactory. Caius, Linneaus, and Buffon, have all presented a tabular view of their origin and relations; yet none having seen that origin, nor having experimentally proved what are the consequences of intermixing species assumed as distinct, and besides being all at variance in their conclusions, we are precluded from adopting the sentiments which they entertained.

The dog is nowhere known to live in the natural state. From periods of the most remote antiquity it has been associated with man; and in those countries where troops run wild in considerable numbers, they constitute the descendants of domesticated dogs, which, during a few antecedent generations, have lost their masters. But the habits of these, which undoubtedly approach nearer to the original condition of the animal,
The dog is entirely a carnivorous animal, and in feeding tears its prey. Farinaceous substances are readily received; but roots, leaves, or fruits are less acceptable, and the bones of most wild fowl rejected. The natural nature of the animal ever betrays itself in seeking, and ravenously devouring, flesh when it can be obtained. Its teeth are calculated to break down the hardest bones in splinters, which are digested in the stomach: and, like most animals whose success is uncertain in capturing prey, the dog can survive a long time on a very slender supply. It drinks, as is well known, by lapping a fluid with its tongue; but it appears to us that this is accomplished by the inverted curvature of the organ, that the fluid is taken up in the edges below, and not by the upper surface of the tongue.

The female carries her young between sixty and sixty-three days: they are blind during nine days after their birth, from a membrane uniting the eye-lids, and not from the imperfection of the eyes. It is said that a repetition of the sexual union does not augment the number of young; an assertion which it would be difficult to prove, though it is extremely probable, that the conception of females is immediate, perhaps instantaneous. It might more correctly be advanced, that several puppies are frequently the result of a single union; and an instance has been given, where the mother, a pointer, having received two dogs of different descriptions, a terrier and a greyhound, she produced two pointers, two terriers, and two greyhounds; the first and last of which proved excellent dogs. The number of young is exceedingly various, being from one to seventeen; which is the largest well authenticated litter that has come within our knowledge, and was the offspring of greyhounds. Generally the litter is between four and ten; most of which we are accustomed to destroy, from supposing the safety of the mother would be endangered by rearing so many young. Possibly the dog is greatly affected by domestication, but in all other situations, nature has enabled the parent to provide for the offspring.

Various other characteristics are given of the dog by different naturalists; such as the tail inclining to the left; the animal running obliquely, resting on the toes, going frequently round the place on which it designs lying down, advancing before its master on a journey, and if the road divides, looking back. But the modifications which the disposition and habits of this animal undergo in an artificial state are so important, that we cannot assume from them what would be its untamed nature. It has been observed, however, that those which have been long emancipated from human dominion, have, to a certain extent, resumed the properties of their race. Their ears are always erect, their sight piercing, and their smell acute; they live in numerous societies, refusing the intermixture of any stranger breed; they hunt in concert, and their voice is seldom heard, unless when in pursuit of prey: they then venture to attack the strongest animals, and repose immediately on the exertions which have procured them sustenance.

The dog, the wolf, the fox, and jackal, are all intimately allied in structure and habits. From some unsuccessful experiments in obtaining young from the dog and the two former, it was believed that they were of different genera; but later observations prove, that this intermixture is practicable; and we certainly see dogs which seem to betray their origin from a less domesticated animal.

Naturalists in general have endeavoured to trace all the varieties of the canine race to one parent stock, which is more commonly thought to centre in the shepherd's dog, so called from always being chosen as the guardian of the flock. This species is pre-eeminently distinguished by sagacity; and those of a genuine breed scarcely require education, for even while puppies they have been seen instinctively collecting the sheep around their master's feet. In South America, Don Felix Azara acquaints us, that they are removed from the mother while blind, and nursed on different ewes; they take the flock to pasture in the morning, and return with it to the fold at sunset. The shepherd's dog is of a middle size; the muzzle rather slender; the ears short, pointed, and erect. The whole body is remarkably hairy, particularly the hips, but the face is smoother than the rest; its covering is calculated to resist the elements. The tail is of considerable length, and bushy; and the colour of the whole animal is black, brown, or modifications of both. Buffon affirms that in France the former is predominant; we believe that it is not so in Britain. Since the days of that naturalist another species has been discovered, which certainly tends to corroborate his theories respecting the aboriginal stock; we mean the dog of New Holland, called Dingo by the natives. Considering the separation of that vast continent from all the civilized parts of the globe, the rudeness of its inhabitants, estranged from every art and improvement; and also, that scarcely any animals dwelling upon it have been recognised in a different region, it is not unlikely that the dog may have been preserved in greater purity, or perhaps altogether free from intermixture for many successive generations. Only a single species has hitherto been found corresponding in every thing excepting size; and on comparing the figure given by Mr White, Governor Phillips, and also on attending to the minute description by M. Frederic Cuvier, the resemblance to the shepherd's dog is at once irresistible.

The New Holland dog is nearly two feet high, the colour dun, but much lighter on the under part of the neck, breast, interior of the thighs, and muzzle. The tail is long and bushy, depressed when the animal listens, at other times elevated or carried straight. As in those animals exposed to the intemperance of climate, the hair close to the skin is short, fine, and woolly; and above, longer and coarse. The ears are short, erect and always pointed forward; and the head is carried high. It is distinguished by great muscular power, and uncommon boldness, readily attacking all other dogs, when opportunity admits: its nature is remarkably savage, and unlike those of the old continent, the domesticated dog of New Holland seems irreclaimably vicious. It seldom barks, and even does so with less facility than the other dogs familiar to us. We are unacquainted with the mode of its propagation, and whether it is ever found without a master, which is the genuine state in which its history is to be studied. Some have been brought both to France and Britain, which ate raw meat with avidity, but always rejected fish, and however agile on the land, proved incapable of swimming.

Except in size, the skeleton of the dog of New Holland can scarcely be distinguished from that of the wolf; the teeth are the same in number, the relation of the bones of the head intimately correspond, the vertebrae of the tail consist of thirteen in both, and there is an
equal number of toes on the feet. The head of the jack-
al being nearer the size of that of the dog of New Hol-
land, presents as striking a similarity; and the principal
difference either in it or the head of the wolf, is seen in
the greater or lesser distance between the cavities of
the eyes. But in comparing the heads of other dogs
with the head of this species, that of the Irish grey-
hound bears the nearest resemblance; and the cranium
is somewhat more capacious in the great Danish dog
and shepherd's dog. Those three Buffon considered
as the primitive races, modified into every variety, by
intermixture and climate.

We find it vain, however, to follow that author, or
indeed any other, through all the varieties of an animal
which breeds promiscuously, and has done so for ages
inmemorial, with every kind and description of its
species, thus adulterating what might have been or-
iginal characters: We shall therefore only notice a
few concerning which there is little room for dis-
pute, and speak of the properties of the dog in general.
Besides, the confusion in which the natural history of
the animal is involved is so great, that we could not at-
tempt to extricate it from error, without engaging in
dry and tedious discussions.

Dogs are extremely various in size, from the Irish
greyhound, Danish dog, or mastiff, down to the small-
est lap dog, not equal to one half the head of any of
them. Brown seems the predominant colour; almost
all others, except red and green, occur in every dif-
ferent shade, but we do not know any instance of these,
though they may possibly be seen elsewhere. Dogs,
confessedly of the same species, are of opposite colours.
Blueish, or slate grey, are less common than others;
black, or brown speckled with white, are rare; and
wherethewholebodyisspotted,large spots are more ge-
nerally disseminated than small ones. These observations,
however, are liable to every modification imaginable,
and localities may have rendered the distinctions more
prominent, by the preference for a certain colour in a
breed, or the partialities of the place.

The Irish greyhound is said to derive its name from
Ireland, where it is now almost extinct, and is one of
the largest of the race, if not exceeding the whole in
size. If we are to credit Dr Goldsmith, some were
known, when he wrote, four feet high, or the size of a
calf a year old; and Buffon says he saw one which
seemed nearly five feet high when sitting; it resembled
the great Danish dog in form, but differed from it in
the enormity of its size; it was entirely white, and of
amild and quiet disposition. More recently, a descrip-
tion of the Irish greyhound has been given by Mr Lam-
bert, who saw eight of these animals in possession of
Lord Altamont, in the year 1790, and they were the
sole remnant of their race, which had then degenerated.
The hair was short and smooth, brown and white, or
black and white. One of the largest dogs was 61
inches long from the muzzle to the point of the tail,
which latter was of itself seventeen inches and a half in
length. The ears were six inches long, and pendulous.
The height from the toe to the top of the fore shoulder
twenty-eight inches and a half; the circumference of
the breast thirty-five inches, and of the belly twenty-
six. All were good tempered; and in former genera-
tions they are said to have bore greater resemblance to
the greyhound. According to Daubenton's measure-
ments of the different parts of the dog, these dimensions
present the greatest analogy with those of the great Da-
nish dog. By the name matin, it is rather to be inferred
that Buffon means the Irish greyhound; but it is diffi-
cult to reconcile his description of it with the animals
now alluded to.

We are not aware that the great Danish dog, though
Great Dan-
not uncommon on the continent, is frequent in Britain, nish dog.

It is particularly distinguished by its size, and, accord-
ing to Daubenton, is chiefly of a brown colour. Buff-
on considers that this dog, the Irish greyhound, and
the common greyhound, are "only the same animal,
though at first sight different. The great Dane is but
an Irish greyhound (matin) better filled up; the com-
mon greyhound, the latter more delicate and slender,
and better treated. There is no greater difference
among the three, than between a Dutchman, a French-
man, and an Italian."

The small Danish dog, leopard, or spotted dog,
which has been lately propagated with considerable
care in Britain, to attend carriages, differs little from
the former, except in size and colour; and although
Daubenton endeavours to prove it a distinct breed, his
reasons are inconclusive. Aldrovandus affirms, that its
trivial name was brachus, and that it was preferred
when spotted like a lynx, although those of uniform
colour were not to be despised. Buffon calls it brachis
dec Bengeale, whence the real derivation of the race is
not to be traced, especially as we observe, in the
older writings in this kingdom, hunting dogs are called
brachis et rachis: Caius says, the latter was applied to
blood-hounds, in Scotland.

The common greyhound is well known from its use
in the chase, and the breed seems preserved in greater
purity than that of most other varieties. It is said
there are three different kinds distinguished by size,
and we find them either rough or perfectly smooth.
It has long been a celebrated dog in Britain, and Mr Strutt has quoted passages to prove that it formerly con-
stituted a valuable and acceptable present. The Itali-
an greyhound narrowly resembles that animal in propor-
tions, and some authors think it is the same degener-
ated. The greyhound is much employed for coursing
or hare hunting in the Greek Islands. Analogous to
this was the gazehound, of which we know very little,
except that it was used in the pursuit of deer; but
whether it was a distinct variety, or only a greyhound
of the largest size, is doubtful; for appellations nearly
the same have been bestowed on dogs, specifically dif-
erent; neither is it evident whence the name is de-
rived. It has been affirmed, that the badger was an-
ciently called a grey, and from this particular species
being used in hunting it, the name was thence bestowed;
however, we cannot subscribe to that etymology, as it
does not rest on repeated example; but in Scotland the
greyhound is simply called a grove.

The bloodhound, foxhound, harrier, and beagle, had
most probably nearly an analogous origin, and have
long existed both on the Continent and in Great Brit-
ain. Few, if any genuine descendants of the first still
remain in this island; the others are not uncommon,
and care is taken to preserve those of the most decided
qualities for the chase. The last is the smallest variety
of hounds.

Pointers are of different kinds, either approaching the
Pointers, pike or appearance of the Danish dog, or being long-
headed setters, as they are commonly called. For centuries,
the English setter has been much esteemed on the Con-
tinent. Caius, in his description of the dogs used by
fowlers, mentions three kinds, the spaniel, the setter,
and water spaniel or finder. This last is the grand
barbet of Buffon, entirely covered with long curled
hair, its ears large, pendulous, and the eyes concealed.
by the roughness of the face. Analogous properties are displayed by dogs externally of very different species in pointing at game; for the English or Spanish pointer, a smooth, robust dog, with a thick muzzle, bears no resemblance to the silky-haired delicate-looking English setter; and again the cocker or springing spaniel seems intimately allied to the latter, whose chief quality is raising the game.

The Turkish or Barbary dog is remarkable for being entirely naked, and destitute of hair; the skin is of a brownish flesh colour. Aldrovandus says, that the first seen in Europe were brought to Italy during his own time, where they were incapable of subsisting or propagating, on account of the cold; and the same observation has been made with respect to those carried to France. Dogs in the warmest climates are frequently destitute of hair, which some authors maintain results from the heat affecting their nature; but others think it is in consequence of the species being different; and Azara remarks that the dogs of South America are both rough and smooth. The origin of the Turkish dog is uncertain, at least it does not frequent all parts of Turkey; and Somnini affirms, that he never met with any of the species there, nor could he learn that it was known in the country.

The turnspit is distinguished by a low, long body, and the fore feet turning outwards, which last peculiarity is wanting in two varieties. The terrier is said to be of two or more kinds; the English, a smooth black or brown dog, generally with a spot above each eye; and the Scotch, smaller, rough, and commonly white. Probably both are of mongrel breeds; as it is likely all, or almost all, the others are, though they be considered of a specific family.

Besides these, there are many other races of dogs enumerated in the Systema Naturae and elsewhere, particularly in the older writings, relative to the chase, but so insufficiently characterised, as absolutely to preclude a history of all the individual species. The Systema includes thirty-four, besides two additional turnspits, and a Peruvian dog. Cains, in the sixteenth century, enumerated sixteen English dogs, distinguishing each by its Latin and English name. Daubenton describes sixteen principal, five secondary races, resulting from the intermixture of the former; and five more the offspring of the mongrels. Thus we shall only observe, that, in addition to those we have mentioned, there are among others, the Pomeranian wolf dog, Siberian and Iceland dog, all allied to the shepherd’s dog, and approaching it in size. The lurcher, rough lurcher, and boar lurcher, which are ill-defined. The Maltese and King Charles’ dog; the mastiff and bull dog. Neither of the latter seems from a pure breed; the pug dog is said to be a diminution of the bull dog; and what we call German poole, seem the mongrel offspring of the great water spaniel. Cains mentions a mongrel called rope, which is probably a breed from the shepherd’s dog, but now known as the colley, whappie, or cur dog in Scotland and England.

In a general view of the nature and disposition of the dog, we find it materially affected by the habits of that portion of mankind among whom it dwells. It undergoes a sensible modification. Vicious and ferocious among savage tribes; gentle and docile with those that are humanized. No animal is of equal docility as to the dog. By a kind of intuitive faculty, he soon learns to distinguish the friends of his master’s family, while his own attachment to him remains unimpaired; they are courteously welcomed to his dwelling, but strangers are angrily repulsed. The animals around him are treated as his master would treat them. A natural enemy to wild beasts; the kitten, the fawn, and the leveret, domesticated along with him, become objects of terror. He is tractable and compliant, subsisting in patience to his master’s resentment, and forgets all his pains in the joy of being restored to a place in his favour. It is from this docility and fidelity of the dog, that mankind have derived the principal services which are now exacted from him: that he has pursued the beasts of the forest in concert with the rudest of our ancestors; or has watched the drawing of the net, or the deadly aim of the more civilized sportsman. Nor is it in aiding the acquisition of subsistence only, that his use is most conspicuous; he boldly stands forward the first to defend it, and is the faithful guardian of the night, whose vigilance never sleeps.

It is not to be denied, however, that amidst the benefits derived from dogs, some may be differently esteemed in different ages. We read that of old, when possessions were insecure, the blood-hound was employed to trace out the thief, and recover the stolen goods; that he would swim a river in course of the pursuit, and immediately discover the footsteps of the culprit on the other side, never ceasing to follow him until he was taken. Thus this animal is put under the protection of the most ancient laws, which enact, that “no one should disturb or stop a blood-hound or man passing with him, to follow thieves, or take malefactors.” Theft was also so common in this island, that a person denying access to the hound, was to be held participant in the crime. There is little doubt that it was known on the continent, and also in England; but the Scottish blood-hound, which is said to have been of large size and elegant proportions, was the most celebrated of all. Conrad Gesner, who wrote nearly 300 years ago, has preserved a figure of the Scottish blood-hound, which he says was transmitted to him by Henry Sinclair, dean of Glasgow, a distinguished character of his era; and Hector Boyce affirms, that it was of a red colour, or black with small spots. There was some difference between it and the English blood-hound, though the properties of the latter were also eminent. Mr. Boyle, in his Treatise on the Air, relates, that having heard wonderful accounts of the acute sense of smell in the Irish hounds hunting wolves, he was induced to make further investigation into the subject; and he was told that the English blood-hound could follow a man by the scent some hours after he had passed over the ground. A relation of his also informed him, that he had expressly made an experiment on the subject, by sending a servant, who had neither killed a deer, nor even touched one, to a certain village four miles distant, from whence he was to proceed to a market-town three miles farther. When the servant had advanced about half way, the dog was let loose, and pursued his footsteps, disregarding all other people in the way; and in the same manner passed through the crowd in the market-place, intent on the object, until coming to the door of a house where the man was resting himself in an upper apartment, and there found him, to the great admiration of all the spectators. We learn from Strabo, that the British blood-hounds were used in the wars of the Gauls; and many centuries later the Spaniards are said to have carried these animals to the continent and islands of America, to aid them in their ferocious attacks on the peaceable inhabitants. There the race is still preserved for its original purpose under other masters, in hunting mankind. In the year 1492, twenty blood-hounds
formed part of the auxiliaries of Columbus, in his contests with the natives of St Domingo. The French, during the recent war in that island, carried on with the revolted negroes, employed blood-hounds regularly trained against them; and they are even said to have had the barbarity of throwing their captives to the dogs to be devoured alive. In training the hounds to this inhuman pursuit, we are told that they were confined in a kennel sparred like a cage, and sparingly supplied with the blood of other animals. The figure of a negro in wicker work, stuffed with blood and entrails, was next provided as they grew a little older, and occasionally exhibited in the upper part of the cage: the dogs ferociously struggled against their confinement, and, as their impatience increased, the effigy was brought nearer and nearer, while their usual subsistence underwent still greater diminution. At length it was resigned to them, and while vociferously tearing it up and devouring the contents, the caresses of the keepers encouraged their perseverance. Thus their animosity to black men was excited in proportion to their attachment to the whites; and they were sent out to the chase when their training was considered complete. The miserable negro had no means of escape: he was either hunted down and torn to pieces, his wife and children perhaps sharing his calamity; or, if taking refuge on a tree, he was betrayed by the yelping of the blood-hounds into the power of his more savage pursuers. This, however, was not the full extent of the evil. "But differently kept in the neighbourhood of Cape François, the dogs frequently broke loose, and infants were devoured in an instant from the public way. At other times they proceeded to the neighbouring woods, and surprising a harmless family of labourers at their simple meal, tore the babe from the breast of its mother, or devoured the whole party, and returned with their horrid jaws drenched in the gore of those who were acknowledged even in the eyes of the French army as innocent, and therefore permitted to furnish them with the produce of their labours." The stages of cruelty are progressive; and those who delight in the torture of animals, will soon be indifferent to the sufferings of mankind. Accordingly, the rude nations universally enjoy ferocious contests, and are gratified with the sight of blood. Lions, tigers, and elephants, have been encouraged to tear each other in pieces, where mutual antipathies ceased to operate; and bulls have been fought against dogs in this country since the days of Claudian. But in the present age, we may be surprised at the toleration of a practice, alike abhorrent to humanity, and inconsistent with the feelings and manners of the British nation. If the baiting of bulls was sport to our ancestors, it certainly ought to excite nothing except commiseration for the pain of an innocent creature, and disgust at the barbarity of those who can enjoy it. In the reign of Henry II. bull-baiting was an amusement of the London populace. Nay, much more recently, Queen Mary entertained the French ambassadors two successive days with an exhibition of this kind in the year 1559. Queen Elizabeth, her sister, repeated it to the ambassadors from Denmark in 1586; and, what is more extraordinary, the queen was herself among the spectators. Paul Hentzner still later describes the cruel diversion of the English people, to whom the baiting of bulls, bears, and badgers, was familiar; and there is even reason to believe that the horse was sometimes publicly worried to death, to glut their savage appetites for a brutal spectacle.

On all these and similar occasions, such as when a bull, jointly pursued by the dogs and their masters, was hunted down or bruised to death with clubs, the minstrels, a miscreant crew, claimed the slaughtered animal as a perquisite. It is long since the worrying of bulls in the streets of London was prohibited, but the practice was widely extended, and the rings to which the bull was chained for the certainty of undergoing aggravated torment, are still extant in many towns and villages, where they are sometimes converted to use. Posterity will scarcely credit, that only a few years have elapsed since this savage custom was defended in the British Parliament, as an innocent recreation, contributing to the health and well-being of the community. But let us leave such prostitution of the courage and fidelity of so valuable an animal as the dog, to consider the benefits conferred by its domestication on mankind.

From a very ancient period, dogs have been converted into beasts of burden, and yoked in harness to carriages; and down to the present day, they are trained to the same services on the Continent of Europe, in Asia, and America. But it is in the frozen regions of the north, where the utility of the dog is so eminently displayed, and where travellers, by its assistance, are enabled to cross trackless deserts of snow, otherwise impassable. Marco Polo, a celebrated Venetian of the thirteenth century, distinctly speaks of a country in the north of Asia, difficult of access on account of the intermediate mud and snow, from which great quantities of furs were carried in vehicles wanting wheels, by means of dogs. The information he received on the subject characterizes the sledges of Greenland or Kamtschatka, now drawn by these animals. In this latter country, the species employed is of a middle size, of various colours, white, black, grey, or black and white, of wolfish aspect, yet not unlike the shepherd's dog, or its mongrel offspring. Its hair is rough, its tail recurved, and the ears pointed; it cannot be taught to hunt, and never barks but howls. Though regularly trained to the draught, the dog of the Kamtschadale and Greenlanders seems less tractable and domesticated than that of civilized countries, proving, perhaps, how much its nature is modified by associations with man. All that are thus occupied are castrated, to preserve them more under control. During the prevalence of ice and snow, from five to ten are harnessed to a light sledge of wicker-work, about three feet long, and one in breadth. The driver is supported by a seat a yard above the ground, and the whole frame rests on two curved pieces of wood, or sometimes whalebone, which operate as skates in gliding over the frozen snow. The total weight of the sledge does not exceed ten pounds, in which journeys incredibly long are safely accomplished. The harness is made of leather; the dogs are arranged in pairs, commonly with a leader of the whole in front, and are fastened together by straps or reins through their collars, fixed by a hook and chain to a ring in the fore part of the sledge. If the journey be difficult, or the burden heavy, the number of dogs is increased; and when M. Lesseps brought the dispatches of La Perouse over land from the harbour of Petropavlovski, 37 dogs were harnessed to his sledge, and 45 to that of the companion of his journey, the governor-general Kasloff. Thirty-five sledges were in company, drawn by nearly 300 dogs. But journeys of this description, though generally successful, are not entirely void of danger. The traveller, whose position is sidewise, and not directed forward, must be careful to preserve the equilibrium of so slight a vehicle; if it inclines to the right, he
must lean to the left, and his posture must be changed when the inclination is reversed. The utmost vigilance is necessary not to be overstept; and if this accident should occur, he must hold vigorously by the sledge, as the dogs once in motion run straight forward, and with greater ardour on the burden being lightened. They are scarce to be restrained on the open way, and on descending steep declivities, Krasseninokoff affirms that all except one are unhked, from the violence with which they rush down. They likewise become unruly on scenting deer, or hearing dogs in the neighbouring villages. Much of the security of the traveller depends on the training of the leader, and the whole are guided by the voice and a crooked stick, without any whip. But the fatigue of long journeys is so great, that the dogs frequently perish under it; food is scanty, and shelter rarely to be obtained. Of the 300 dogs employed by M. Lessep's party in crossing the peninsula of Kamtschatka, only twenty-seven at last remained; many died of want and exertion; others when tied up ate the cords and harness from hunger; and some dived the carriage wheels to which they had perished. Nevertheless, their speed, strength, and patience of privations, are remarkable. Egeden, the Danish missionary, affirms, that the dogs of the Greenlanders sometimes drags a sledge fifteen German, or about sixty English miles over the ice, in a day, and Captain King relates, that a courier performed a journey of 270 miles by means of them, in less than four days. Yet these animals are very sparingly fed, and in summer altogether neglected. At that time they are turned loose to provide for themselves, when they catch fish and dig for mice: they are recalled by their masters in October, when well fattened, by their liberty, and tied up near the huts, until becoming leaner and better adapted for the draught. Only a small proportion of the whole remain unmuti lated, for the purpose of preserving the breed.

Lipsins, an author of the sixteenth century, tells us, that a dog, apparently the English mastiff, was used in his youth, at Brussels, to draw carts laden with hides to market; and that dogs were even sent without a master to bring commodities. This has been continued in Holland down to the present time; and dogs are constantly seen drawing men, or loads of fish and provisions, in vehicles adapted to their size. In Canada also they are occupied in drawing a small cart or sledge, heavily laden, not less than 200 pounds being sometimes dragged along by a single animal. Wheel carts are used in summer and sledges in winter, all proportioned to the size and strength of the creatures yoked to them. There is said to be no particular species, but all sorts and sizes are thus employed, in dragging children, water from the rivers, and other things for domestic purposes. In Newfoundland, dogs are occupied in drawing down quantities of wood on sledges to the sea, from the interior, and being generally large, they are capable of more severe labour; but they are so well trained, as to perform it without the guidance of a master. Of late years, a few are likewise used in England, to draw incalculable weights.

Instances of docility. We are daily presented with wonderful examples of the docility of animals; but none is so universally susceptible of education as the dog. He is more the natural companion of man; his attachment is warmer, his fidelity more unshaken: he is ever alive to the interests of his master, and seems to have no enjoyment equal to his society. It is not surprising, if a creature possessing such properties, has sometimes been rewarded with reciprocal regard: and that unusual care should be taken to teach him, in preference, peculiar feats of address, which seem denied to the powers of others. Our limits prevent us from here entering on what would be an amusing narrative, except to remark, that Plutarch has preserved an account of a dog exhibited to the emperor Vespasian, which has scarcely been rivalled in any example of modern tuition. This dog belonged to an actor; and nothing could be more skilful in scenic representation, and in imitating various circumstances and situations. It exhibited in itself the execution of a malefactor, feigned the taking of poison, and the tremor following its sudden operation; then, falling down, its limbs were stretched out in perfect resemblance of death; and so it remained for a certain time, until, by a word from its master, it gradually opened its eyes, looked languidly around, and at length recovered. But in the course of last century, an exhibition somewhat similar took place in Britain, where the storming of a fort was imitated by dogs, attended by the feigned destruction of some of the party; and we have witnessed the performance many times by these animals, such as the solution of arithmetical questions, the selection of certain cards, from a pack spread out, to denote the hour of a watch. A dog has also been taught to carry a glass of wine on a salver without spilling it, in which we are reminded of a female wolf, shut up with a companion, that could take up a platter of food with her teeth, and run round the kennel, preserving the whole in safety. The account of a dog that was taught to speak, which has often been incorrectly referred to, should not be omitted here; and we shall quote the original description entire from the memoirs of the French academy. "Without the testimony of such a person as M. Leibnitz, an eye witness, we should not have ventured to mention, that near Zeitiz in Misnia, there is a dog which speaks. It belongs to a peasant; is of the most ordinary kind, and of middling size. A young child having heard it utter some sounds, which he thought resembled German words, took a fancy to teach it to speak. The master, having nothing better to do, spared neither time nor trouble; and happily the pupil had dispositions difficult to be found in another. At length, after some years, the dog could pronounce about thirty words, among which were tea, coffee, assembly, adopted from French into the German language. Its tuition commenced when it was three years old. The expressions of its master are only echoed, that is, after he has pronounced a word, he compels it, apparently unwilling to follow his example, though no severity be required. We repeat, that it has been seen and heard by M. Leibnitz." Certainly this is a very astonishing faculty; but the account of the French academicians, derives support from other examples, though, it must be acknowledged, that the circumstances are not detailed with sufficient distinctness and accuracy.

The speed and energy of the dog are very great. Speed. The distance which it can travel without repose is almost incredible. Fox-hounds in the chase, and pointers in pursuit of game, cannot traverse less than from 100 to 150 miles in a single day; and we have seen that those of a Kamtschatkafalour carried their burden 270 miles in three days and a half. It cannot have escaped notice, that a terrier frequently accompanies our mail coaches, at the same rate during a stage or more. We have instances, well authenticated, of a fox-hound running four miles in seven minutes, or at the rate of thirty-four miles an hour; and experiment has proved, that the speed of the greyhound equalled
that of the swiftest race horse. For dogs, possessed of properties such as these, the lovers of rural sports in Britain have been content to pay extravagant prices. Four hogheads of claret were not long ago exchanged for a foxhound as its value, two hundred guineas were given for a brace of pointers, and L.153 for a single greyhound.

The ancients ate puppies as a delicacy, and they offered them in sacrifice to their gods. Dogs are generally an article of food in the South Sea islands, and provided to regale the visitors of the inhabitants. In various parts of Africa, they are held in like estimation; and in the kingdoms of Whidaw and Dahomy their flesh is exposed for sale in the public markets. In different foreign countries the skin is used for clothing, and at home the finest leather is prepared from it. Neither have the different parts of the animal been judged void of medicinal properties: the fat was formerly thought to be an excellent vulnerary; and an oil or balsam extracted from puppies, by roasting or boiling, was dealt out as a powerful remedy for strains, contusions, and muscular debility. Quacks and empirics, resting their nostrums on the credulity of mankind, find a specific in every thing.

The dog, in common with other animals, is subject to multiform diseases, of which the most dreadful is madness; more dreadful than those afflicting the rest of the brute creation, because a fatal wound may be communicated from it. The most usual symptoms are said to be dulness, loss of appetite, and in particular a departure from the animal's ordinary habits. If a stick, held out by a person with whom it is familiar, excites resentment, this is reputed an infallible criterion. But the dog still continues tractable, and the persons generally around it are the last in danger of attack. Its voice next participates more of a continued howl, with the head elevated in the air; great anxiety appears; it labours under apparent suffering, and testifies the strongest impatience of control. At length it eagerly hurries from the home to which it has always been attached, it bites every animal in its way, its pursuit is incessant of all except mankind, for they are more rarely the objects of injury; and when worn out with wandering, it will sometimes return. If escaping intentional destruction, the dog seldom survives the fourth or fifth day, refusing all food, and dying raging mad. It is a lamentable fact, that a mortal malady, known by the name of hydrophobia, may be imparted by the bite of a dog indisputably rabid; but this distemper does not invariably ensue; neither ought it to be correctly designed the dread of water, for some dogs lap that fluid readily, from the fever affecting them, though they are unable to swallow it. Instant excision of the wounded part is always considered prudent where it may be safely performed; and of late excessive bleeding, such as repeatedly deprives the patient of sense and motion, seems to have been practised with success.

The dog is a long-lived animal; twelve or fourteen years being its usual age, but some reach twenty. All the marks of age are long before conspicuous; the hair alters, the eyes grow dim, the hind legs become paralytic; weakness and extenuation terminate in death. See Pliny Hist. Natur. lib. viii. Strabo, lib. iv. Ælian. de Natura Animalium. Aldrovandus de Quadrupedibus digitatil, &c. lib. ii. Conrad Gesner Icones animalium, p. 25. Caius, de canibus Britannicis, ad Gesnerum var. loc. Buffon Histoire Naturelle, tom. v. and xiv. F. Cu- vey sur le Chien de la Nouvelle Hollande ap. Ann. du


DOIRE, one of the six departments of France into which the principality of Piedmont was divided in 1802. See PIEDMONT.

DOLA. See ARABIA.

DOLE, the Dola Sequanorum of the ancients, is a handsome town of France, in the department of the Jura. It is the largest town of Franche Comté except Besançon, and was once the capital of the province, and the seat of its parliament and university. The town is situated in a fertile plain, on the right bank of the river Doubs. It was once very strong, but the fortifications were demolished by Louis XIV. It has a college, 12 convents, and a hospital. The university was transferred to Besançon by Louis XIV. Dole has a manufacture of hats and hosiery goods, a forge, and a glassworks; and in the neighbourhood there are mines of iron, copper and coal, and quarries of beautiful marble. The surrounding country is fertile, and produces abundance of wine and corn, in which a considerable trade is carried on, which is facilitated by a canal. Population 8235. It is 50 miles south-west of Besançon, and 270 south-east of Paris. (j)

DOLGELLY, or Dolgellau, is a market town of Wales, in the county of Merioneth, and derives its name from dol or dal, and gelli or eelli, a grove of hazel trees. It is situated in a fertile vale, between the rivers Arran and Wnion, and is circled with lofty mountains, many of which are covered with wood. The streets are very irregular, and so narrow as scarcely to admit two carriages abreast. The houses are built of quartz, or limestone, without mortar. They are seldom above two stories high, and have penthouses in front upon piles. The church, which is the neatest building in the town, is built of limetone, and consists of a tower and a large nave. The seats are merely forms. The market-house is a low square building, and the town-hall can scarcely be distinguished from the other houses. The county gaol, which has lately been erected at a small distance from the town, is a strong and handsome building. A considerable trade is carried on here in flannel, a kind of kerseymer cloth, and a woollen cloth called gree, which is manufactured in the town and neighbourhood. Shrewsbury and Liverpool were formerly the principal markets for these goods, but agents now resort to Dolgelly to purchase them. There is here a weekly market on Tuesdays, and six annual fairs. The following is an abstract of the population return for the town in 1811:

Number of inhabited houses, ............ 537
Number of families, ........................ 728
Do. employed in agriculture, .......... 239
Do. in trade and manufactures, ........ 70
DOLCHOS, a genus of plants of the class Diadelphin, and order Decandria. See Botany, p. 277.

DOLLOND, John, a celebrated optician, who has immortalised his name by the great discovery of the achromatic telescope. He was born in Spitalfields, London, on the 10th of June 1706, of French parents, who had fled from Nantes in consequence of the revocation of the edict of that city. In the early part of his life, Mr Dollond wrotht at the loom, but before the age of 15, he had acquired a taste for philosophical and mathematical pursuits, and spent his leisure hours in studying elementary works of science, and in the construction of sun-dials and geometrical figures. In this way he acquired a knowledge of geometry and algebra; and though his opportunities for study were diminished by an early marriage, and the cares of an increasing family, yet his ardour for knowledge was unextinguished, and he contrived, by abridging his hours of repose, to acquire a profound knowledge of optics and astronomy. His attention was also directed to anatomy and divinity; and he even found leisure to acquire the Latin and Greek languages, in order that he might apply himself more successfully to his favourite pursuits.

Mr Dollond, along with his son Mr Peter Dollond, carried on for some time the business of manufacturers; but the extensive information which the son had acquired from his father's instructions, induced him to commence optician. The success with which this plan was attended, prompted his father to join him in his new profession, an event which happened in the year 1752.

After acquiring a practical knowledge of optics, Mr John Dollond directed his attention to the improvement of the eye-glasses of refracting telescopes, and he succeeded in producing an eye-piece of four glasses and sometimes afterwards an eye-piece of five glasses, which greatly surpassed those in common use. An account of these eye-pieces was read before the Royal Society in 1758, and afterwards published in the 4th volume of their Transactions.

The next effort of Mr Dollond, was an improvement of the double image micrometer, or heliometer, which was invented by Savary and Bouguer. This improvement consisted in using two seminacles instead of two whole object glasses, and has already been fully described in our article Astronomy. See Vol. II. p. 724.

Mr Dollond's attention was now turned to the improvement of the refracting telescope, and his labours were crowned, by the invention of one of the finest instruments that has ever been constructed. The various steps by which he was conducted to this splendid result, have already been fully detailed in our history of the Achromatic Telescope, so that we must refer our readers to that article for further information. In honour of this invention, the Royal Society of London presented Mr Dollond with Sir Godfrey Copley's medal. This learned body also elected him a fellow of their Society in 1761, and in the same year he was appointed optician to his majesty. These honours, however, he did not live long to enjoy. While reading Clairaut's theory of the moon, with which he had been intensely occupied for several hours, he was struck with apoplexy, of which he died in a few hours, on the 30th of November 1761, in the 55th year of his age. Mr Dollond left behind him two sons and three daughters; and his business was carried on by his sons and his nephew Mr George Huggens, who took the name of Dollond.

Mr Dollond was a man highly respected in his moral and religious character. "In his appearance," says Dr Kelly, "he was grave, and the strong lines of his face were marked with deep thought and reflection; but in his intercourse with his family and friends, he was cheerful and affectionate; and his language and sentiments are distinctly recollected, as always making a strong impression on the minds of those with whom he conversed. His memory was extraordinarily retentive; and, amidst the variety of his reading, he could collect and quote the most important passages of every book which he had at any time perused." See Dr Kelly's Life of John Dollond, and the articles Achromatic Telescope, Astronomy, Clairaut, Optics, and Telescope. (X)

DOLPHIN. See Ichthyology.

DOME, or Cupola, a kind of vaulted roof or covering, employed in architecture, in the shape of some portion of a sphere, ellipsoid, &c. and frequently constructed of masonry. Domes differ in some respects from common arches, which are cylindric convexities, resting on parallel walls, and having therefore a curvature only in one direction; whereas domes, as also groins, have a double curvature, and derive a degree of stability from this circumstance, which is peculiarly deserving the attention of the architect. We shall treat of this subject under the article Groins, comprehending therein roofs formed upon curvilinear as well as upon polygonal plans. See Groins; and Carpentry, Part II. p. 528. (A. N.)

DOMEA, is the name of a town, situated on a river of the same name, which is the principal branch of the Tunkin river, and discharges itself into the Gulf of Tunkin, about 20 leagues north-east of the former, in North Lat. 20° 50'. The town of Doma is about six or seven leagues from the mouth of the river, is situated on the right hand side close to the shore, and is a handsome place, containing about 100 houses. The Dutch vessels that trade here generally lie before the town, while the English vessels proceed about three miles farther up, and erect bankshaws during the time that they remain. As pilots are necessary to conduct vessels over the bar at the mouth of the river, a number of them live at a village called Batsha, situated near its mouth. The vessels should anchor, and wait for a pilot, when a small island, called Pearl Island, on the east side of the road, is about N.E. and three miles distant; and when a mountain island, called the Elephant, is about N.W. by W. The river is about a mile wide at its mouth. Its depth, in the northerly monsoon, is 26 feet, and in the southerly not above 18. See Milburn's Oriental Commerce, vol. ii. p. 458. (m)

DOMESDAY-BOOK, contains a survey of most of the lands in England, made by the orders of William the Conqueror. The etymology of the name is rather uncertain; some suppose it to be derived from the circumstance that the survey was deposited in a place called Domus dei; but the more probable derivation is from dom, or doom, judgment; because by this survey all disputes respecting landed property, and the tenure by which it was held, were to be decided. The original and proper name seems to have been Dom-boc. There is also some difference of opinion concerning the object which William had in view, in causing this sur-
Some antiquarians supposing that it was merely that each man might know his property, while others contend that it was for the purpose of establishing bounds, and that there was some necessity to cause a survey to be made for the other purpose, as that had been effectually done by Alfred. That this opinion is well founded, a reference to the state and circumstances of the kingdom, just before the survey was made, will probably induce most of our readers to admit. Although William, immediately after the conquest, put his Norman barons in possession of the restricted lands, which they were to hold by the tenure of military service, yet the landed property, which the Saxon nobility possessed, was not held in this tenure; the consequence was, that the old military constitution being laid aside, and no other generally introduced in its stead, the kingdom was nearly defenceless. When therefore an invasion was apprehended from Denmark, William was under the necessity of bringing over a large army of Normans and Britons, the support of whom greatly oppressed the people. As soon as the danger of invasion was over, William resolved to introduce the feudal system over the whole kingdom; and for this purpose he held a great council, as the Saxon Chronicle expresses it, in which he took the advice of his nobility respecting this country, how it should be held, and by what persons. One of the results of this council was the survey contained in Domesday Book; and as soon as it was completed, the king was attended by all his barons at Sarum, where the principal land-holders submitted their lands to military tenure, became the king's vassals, and did homage and fealty to his person. These circumstances seem to prove what was the object of making the survey; and this view of it is farther confirmed by the nature of the survey itself.

In order that it might be faithfully and strictly executed, some of the king's barons were sent as commission- ers into every shire. Their first step was to summon juries in every hundred; these juries were taken from all orders of freemen, from the barons down to the lowest farmers; and they took an oath that they would inform the commissioners what was the name of each manor, who had occupied it in the time of Edward the Confessor, and who held it then; how many hides, how much wood, how much pasture, how much meadow land it contained; how many ploughs were in the demesne part of it, and how many in the tenant- ed part; how many mills, how many fish-ponds or fisheries belonged to it; what had been added to it, or taken away from it; what was the value of the whole together, in the time of Edward; what when granted by the Conqueror; and what at the time of the survey; and whether it might be improved or advanced in its value. They were also required to give in a list of all the tenures of every degree, and to state who had them, each of them had held, or did hold at that time, and what was the number of the slaves; a particular account of the live stock on each manor was also to be returned. When returns respecting all these particulars were made, they were methodised in the county, and afterwards transmitted to the king's exchequer. There are two volumes of Domesday Book; the first is a large folio, finely written on 382 leaves of vellum, in a small plain character, and double columns; it contains 31 counties; the other, which is sometimes called the lesser Domesday Book, is in quarto, written on 450 leaves, in single columns, and in a fair large hand; it contains Essex, Norfolk, and Suffolk; it is supposed to contain the original surveys returned from these counties. In these the live stock is noted. The greater Domesday, compiled from the originals by the officials of the exchequer, omits this live stock, and gives some other particulars with more brevity. The ancient demesne or landed estate of the crown, as given in Domesday, consisted of 1424 manors, in different counties, besides some scattered lands, and farms, and quit rents, paid out of several other manors. From this survey it appears that the boundaries of the counties were not exactly the same then that they are now, since part of Rutlandshire is included in Northamptonshire; and parts of Westmoreland, and Lancashire, are included in Yorkshire and Cheshire. Northumberland, Cumberland, and Durham, are not noticed. Different reasons are assigned for this omission: Hume supposes it arose from their wild uncultivated estate; others, because they contained no terra regis; that the survey was never completed, or that the ravages of war rendered it unsafe. Pinkerton is of opinion, that Northumberland and Durham were omitted, because they were in possession of the Danes; and Cumberland, because it belonged to Scotland; but William seems to have considered Cumberland as belonging to himself, for when he quarrelled with Malcolm the Third, he gave it to Ranulph de Meschines. London is also omitted in Domesday Book. Although the survey was rigid in almost every instance, yet some of the returns are said to have been partial and false. Ingulphus, Abbot of Croyland, says, that with respect to his abbey, the lands were under-measured, and under-rated; and it is said that Ralph Flamard, minister to William Rufus, was so convinced that many of the returns were partial, or erroneous, that he resolved to make another more rigorous inquisition; if this were the case, it never was put in execution. In the orthography of the names, the Norman scribes made many mistakes, setting them down from the Saxon pronunciation. At the end of the Liber Eliensis, (Cott. Lib. Tib. A. 6. 4.) are some of the original rotuli, whence it was compiled for Cambridgeshire; and in the library of the dean and chapter of Exeter, there is a similar survey of the three western counties, an extract from which is given by Hutchins in his History of Dorsetshire. A fac simile, by way of specimen, is given at the end of Morant's Essex; another in the Registrum honoris de Richmond; and a third in Nichol's Leicestershire; that in Hiche's Thesaurus is not well executed. In the Harleian MS. of Elincts Saxon Grammar, the Numerus Hidorum is given more accurately than in the Appendix to Sale's Hist. Angl. Script. That part of Domesday which relates to Wiltshire has been published in English by Mr Wyndham; and that relating to Leicestershire by Mr Nichols. Mr Bawdwen published "Dom-boe," a translation of Domesday for Yorkshire, and such parts of Westmoreland and Cumberland as comprised in the survey; likewise Derbyshire, Nottinghamshire, Rutlandshire, and Lincolnshire, with an introduction, glossary, and indices; but the most complete illustration of Domesday was published by Mr Kelham, under the title of "Domesday Illustrated." In 1777, it was determined by government to print the whole of it, and after much delay, from various causes, this great work is now completed; the commissioners of public records have likewise printed four indices to it. It is still considered as of very high and unquestioned authority, for the establishment of tenures, and in the article of Taillage. Blackstone says, "whether a manor be held in ancient demesne or not, shall be tried by the record of Domes-
day, in the king's exchequer." See Domesday Illustrated, by Kelham. Littleton's History of Henry the Second, vol. iii. 8vo. edition. There are also several curious notices respecting Domesday Book scattered up and down in Nicholl's Literary History of the Eighteenth Century. (w.s.)

DOMINGO, St., or HISPANIOLA, is the second in point of size, and one of the most fertile of the islands forming the American Archipelago; its dimensions have not been accurately ascertained; but, according to the best authorities, it is 170 leagues in length, 30 in breadth in the middle, and about 360 in circumference. By the natives it is called Haiti, or the Highland Country, on account of the hilly nature of its north division. They also give it the name of Quisqueya, or the mother of countries. When it was first discovered by Columbus, he called it Isabella, in honour of the Queen of Spain; but it soon afterwards was denominated St Domingo after the principal city in the island. It is situated among the islands of Cuba, Jamaica, and Porto Rico, from the last of which it is separated only by a channel: it extends from 17° 37' to 29° north latitude, and from 67° 35' to 74° 15' west longitude. Several small islands lie round St Domingo, the principal of which are: Altarde, Saone, Beate, St Catherine, on the south side from west to east; Mone, and Monique, on the south east side; Gaymote and Conve, on the west; and La Tortue on the north side.

This island is divided into two parts; that which is now strictly and properly called Haiti, and Hispaniola; the former comprehends the ancient French division; and the latter what belongs to the Spaniards: the ancient divisional line which separated these two parts stretched from the river Pedernales on the south side, to the river Massacre on the north side, at the head of the bay of Manecenille: the Spanish part is reckoned to contain about 90 leagues, in its extreme length from east to west, and about 60 leagues in its greatest breadth, having a surface of about 3200 square leagues; of this surface, nearly 400 square leagues are mountainous; but these mountains are much more capable of cultivation than those in the Haitian division; the soil being little inferior in point of fertility to that of the valleys. The division of Haiti extends 400 miles in length and 140 in breadth; it contains 2,500,000 acres, of which 1,500,000 were in high cultivation before the commencement of the French revolution in 1789: it is for the most part mountainous, but fertile, and full of woods, and mines of silver and iron.

The climate of the whole island is very hot, but the effect of the heat is considerably moderated by the winds and frequent heavy falls of rain; these, however, render it so very damp, that most things become putrescent in a very short space of time. In the plains, in the Spanish part, the heat is nearly uniform, sometimes rising as high as 99°; but as the mountains are approached, it gradually subsides; on them, it rarely rises above 72° or 77°; and during the night, the temperature is so cool as to render covering necessary; on some of the highest mountains, as those of Cibao, Llille, and Holte, the former of which is estimated at about 6000 feet above the level of the sea, a fire is frequently requisite. In the central part of the island, the plains of Banian border on the more elevated districts of St John and St Thomas: the western former, the degree of heat is so perceptibly greater, as according to Walton, to cause a diminutive size in the inhabitants, compared with those of St John's and St Thomas. The valley of Costanza, which is divided from the district of St John's by a high ridge of mountains, and is closed in like an amphitheatre by surrounding hills, has a still cooler climate: meat there can be preserved five or six days untainted: hoar frost is frequently seen in the evening, and a fire is generally necessary. The climate may be divided into two seasons; the wet and dry: the heaviest rains fall in May and June; the prevalent winds are from the east, which cool the air; a south or west wind renders it sultry. In January north winds are not uncommon; they occasion a cold dryness in the atmosphere. Sea and land winds are common; about 10 o'clock in the morning, the regular easterly breeze sets in; towards the evening, the land wind springs up, but it does not reach to a great distance from the shores. Hurricanes are seldom experienced; when they occur, they are preceded by a close sultriness of the atmosphere; earthquakes are not now nearly so frequent as formerly. In the southern part of the island, violent gales of wind are not uncommon, but they are not attended with such dreadful consequences as the hurricanes in the windward islands. The principal cause of the unhealthiness of the climate of St Domingo seems to be the alternation of violent heats and heavy rains; and as this alternation prevails in a greater degree, and more frequently on the sea shore, it is more unhealthy than the interior parts of the island. The moisture of the climate has been already noticed; and from this cause, as well as from the attacks of small insects, while the French held possession of the west end of the island, copies of all the transactions and records were transmitted to Paris, to secure them from the destruction of the colonial climate. Walton remarks, that even the texture of the paper is destroyed.

The soil in general is a rich clay; in some places mixed with light gravel, lying on a substratum of rock. It is remarked that the upper soil is deep, in proportion as it is less humid, and easily broken. In this kind of soil, vegetable remains are often found. The direction of the hills in St Domingo is similar to that on the other islands, being parallel with the bearing of the island; their summits form a regular curve; there are two great chains of mountains, which stretch from east to west; from these numerous spurs branch out. Cibao, one of the loftiest, has been already stated to be about 6000 feet above the level of the sea. The Valleys are very numerous, and in general extensive and fertile. The valley of La Vega Real is one of the largest and finest in the island; its length is computed at 80 leagues, and its breadth at 10, and in some places at 15. To the east of the city of St Domingo, are those immense plains, which are emphatically called Los Llanos; they are perfectly level; with no trees upon them, except a few small shrubs on the margin of the springs or pools of water. These plains are said to occupy nearly a sixth part of the island, stretching almost to the east end, a distance of more than 90 miles, while their breadth is about 30 miles. The River Ozama is watered by several rivers, the principal of which are Ozama, Haina, Nigu, Villegas, Norsac, Ocoa, and Yane; they take their rise in the mountains, and in general descend towards the west. There are, however, some which flow to the north and east; but these are not so large as the others. Ozama falls into the sea at the city of St Domingo, where it is as wide as the Thames at Chelsea; about a league above the city it is joined by the Isabella. In rainy seasons, the current is very rapid and strong; and the colour of
the water muddy for several miles; over the bar there is from 14 to 15 feet depth of water. This river is a great convenience to the city, in conveying down provisions and produce from the interior. There is no bridge over it; but the cattle are swan across, even when the current is very powerful, with wonderful ease and dexterity. About 3 leagues to the west of the city of St Domingo, the Haina flows; it takes its rise at the foot of a beautiful ridge of mountains, which terminate the prospect from the city; its course is very winding through the valleys; it falls into a bay of the same name; it is navigable at some distance up, but not near its exit into the bay, owing to an irregular bar of sand. The river Nigua rises near the Haina; its course is so very serpentine, that in travelling two miles, it is necessary to cross it five times. The length of its whole course is nine leagues; in its progress it receives several smaller streams; in the dry season it is very low, and except when greatly swelled by the rains, is easily and safely forded; much wood is floated down it. The river Yane flows through an extent of nearly 200 miles, and waters the rich plains of La Vega Real, Cotuy, &c.: it receives upwards of 40 smaller streams, and falls into the great bay of Samana. This bay, in point of situation, extent, and communication with the interior of the country, is one of the most important in the West Indies. From a sugar loaf hill, we have Cape Raphael, which forms the south side of this bay; to the opposite side is a distance of 18 miles, protected by rocks and sands, yet leaving a safe and deep channel: it is 60 miles long, and bounded on every side by a fertile country. This most important bay seems to have been much neglected by the Spaniards, but when the Spanish division was ceded to France, that government ordered it to be surveyed in a very exact and particular manner; even before the cession of the Spanish division, they attempted to gain possession of a tract of land, cut off by a line drawn 12 leagues inland of Degason to Cape Raphael, which would have included the bay of Samana. This attempt they made in consequence of their justly regarding this bay as the key to the Mexican gulf, from its windward and commanding situation; they also looked forward, by obtaining it, to the possession of the river Yane, the sea ports to the north, the rich mines of Cibao, and the finest tobacco lands in the island: in this project they were defeated, but when the whole of the Spanish divisions were ceded, the French officers used all their endeavours and interest to have land ceded to them near the bay of Samana. There are several other bays, some of which require to be noticed: Neyba bay, into which a river of the same name enters, might be made large and commodious for shipping, if the various channels, through which the river flows into it, were formed into one; at present the depth of water is small, and the pilots, from the number and frequent shifting of the channels, are often at a loss for the proper navigation. The entrance of Ocoa bay, which is denominated from a river of the same name, is two leagues across; and it increases gradually within nearly to six leagues. Its shape resembles the Greek omega; its shores are clear, and their elevation makes it a good place for shelter. On the east side of the bay is the harbour of Culdera. Here Spanish ships, which draw too much water to cross the bar, lie to complete their loading, moored to the trees with a rafter ashore. A great part of the coast of the island is rocky and dangerous, affording insecure anchorage or shelter from storms.

Formerly there appear to have been considerable mines of gold, silver, copper, and iron; but the mines of the two former metals have long been closed by order of the Spanish government, probably from a wish not to interfere with the mines of the American continent. About eight leagues from the city of St Domingo, the mines, known by the name of Buena Ventura, were situated; from one of these mines, called Cibao, a piece of gold, weighing 200 ounces, was obtained; when it was assayed, it was ascertained that the metal was so very pure that 20 ounces would not be lost in the melting; it was unfortunately lost in its passage to Europe. Even at this time, in the neighbourhood of these mines, the inhabitants, after heavy rains, find among the sands of the rivulet, Santa Rosa, small particles of gold, sometimes to the amount of an ounce a-day. In the centre of the island, are also remains and vestiges of extensive gold mines; these were the first that were wrought, and at one time were very productive. In the southern part of the island are the mines of Guaba, Rubia, and Baoruco; gold is still found here in small quantities, with little or no trouble or difficulty, especially by the Maroons, who inhabit this part of the island. On the borders of the small streams called Obispo and Piedras, there is a rich silver mine; and not far from the capital, an excellent vein of this metal has been wrought. On a ridge called Maymon, near the centre of the island, there is a copper mine; and within a very few leagues of the city of St Domingo, there are two valuable mines of iron. In the year 1645, quicksilver was found at the source of the river Yaque; and it has also been met with near the gold mines of Cibao. Emeralds have been dug not far from the copper mine already mentioned; the leadstone is found in several places; and also jasper, porphyry, alabaster, and agates. Besides these, Walton mentions a mine of antimony, which yields pieces of six and eight pounds, and what he calls mineral copperas. The mineral treasures of this island are, however, very imperfectly known, though, from the accounts given by Herrera, and other Spanish authors, they seem to have been the object of very scientific and accurate investigation; according to him, the mines of La Vega and Buena Ventura alone, formerly exported upwards of 460,000 marks of gold. No mineral waters have been discovered in St Domingo, except those which suddenly burst forth from the mountains of Viagama, in consequence of the dreadful shocks of earthquakes, which were felt in this part of the island, in the year 1751: they are strongly impregnated with sulphur. One of the most singular natural curiosities in the island is the lake of Henriquello, or the Little Henry; it lies near the south part, of the French line of demarcation, forming one side of the beautiful valley of Neyba. This lake is about 22 leagues in circumference; the water is deep, clear, and salt, though its nearest margin is eight leagues distant from the sea, from which it is divided by several considerable mountains; and what is still more remarkable, there are regular tides in it, at the same time that they take place in the neighbouring ocean; lizards, alligators, and even the shark, seal, porpoise, and other sea fish, are found in it. Near the middle is an island about two leagues long, and a league wide, in which is a spring of fresh water, stocked with goats, and thence called Cabrito island.

The vegetable productions of St Domingo are exceedingly numerous, and some of them are very curious and valuable. The mahogany tree, which is at present the staple export commodity of the country, is
very abundant; by the old Spanish laws it was deemed unlawful to cut it; such as grow in a dry barren soil is harder, more close in the grain, and more finely variegated, than what grows in low damp situations. Walton says, that he has seen a canoe formed out of the trunk of the mahogany tree, capable of holding 100 men. The oak, though of the same species as that of Europe, differs considerably in its appearance; it is used for buildings, and frequently furnishes beams from 60 to 70 feet long. The *haena* is a tree very similar to the oak, but its wood is still more durable. The *chicle* affords a most beautifully veined wood; but it is dangerous to work at it in contact with the poisonous juice which it contains. There are several woods for dyeing, but none of them have been tried, or even accurately described, except the *fusíce*; there is another tree, somewhat resembling the *fusíce*, which affords a beautiful dye of a more greenish yellow. Two kinds of lignum viwe grow along the coast; the *quebrach hacho* (break axe) is of the same species; it has the peculirity of becoming nearly as hard as stone, when stuck in damp ground. The Spaniards generally build their vessels of a tree called the *capan*, which, however, seems better suited for sheathing ships. The pine is abundant, but in consequence of its being very liable to be attacked by the wood ant, it is seldom employed. Brazil wood is found on many parts of the coast, but hitherto it is not much attended to. The satin wood of St Domingo is heavier than that which grows in the East Indies; but it takes a much better polish, and does not require to be varnished: the value of it is nearly equal to that of mahogany. Of all the vegetable productions of the island, the *seiba*, or cotton tree, is the largest; of it the lightest and most capacious canoes are made; it receives its name from a down, which it affords, resembling cotton, but of a shorter staple, not unlike the down of the black poplar; with this substance the Spaniards stuff their beds; and some successful attempts have been made to form hats of it. The juice of the fruit of the *jagua* is as clear as water, yet it gives a stain to linen of a dark black colour, which is very permanent; on account of this quality, it has been used for dyeing; it is also employed in baths as an astrigent. Of the wood of this tree, which is firm, straight, and supple, the natives make their best lances. The fruit of the *genopa*, or sand box tree, is more singular than valuable; "it resembles a perfect sand box, of a round form, with little raised regular divisions, in shape such as we give a cake by means of a pattcy pan, which terminates in small fibres in the centre, through which the sand filters, and drops into the inside. The traveller is sometimes startled in riding under them, by a noise resembling the discharge of a pistol; but finds it is the fruit that has exploded, and shivered in a thousand pieces;" the sap is of a very acrid nature, and if it falls into the eye produces excruciating pain, and even in some cases blindness. Green and black ebony, granadillo, and the palmetto, or mountain cabbage, are very common; the annual growth of the last is marked by a dark circle, at about the regular distance of three inches. The roofs of the houses are covered with the envelope of the cabbage, which fails periodically every month to the ground; it is about three feet long and one broad. The juice of the dwarf palmetto is called *alegro cogate*, or **livener of the brain**, by the natives, from the property which it is said to possess of raising depressed spirits, when applied to the temples and back of the neck. The sugar cane, cotton, and coffee plants, flourish remarkably well in St Domingo. The sugar would be of an excellent quality, were it properly and carefully manufactured. The quality of the coffee is remarkably good, little inferior, it is said, to that of Mocha; each tree, if properly attended to, will produce, on an average, a pound weight. Cotton, of an excellent quality, grows naturally, even in the stony soil, and in the crevices of the rocks. Indigo seems at one time to have been greatly cultivated; but at present it is in a great measure neglected. The kernel of the cocoa nut of St Domingo is more acidulated than that of Venezuela and the Canarrieas; and the chocolate made from it is esteemed to possess a higher flavour. The plaintain, banana, or fig plantain, calabash, and cashew nut, are abundant. Vanilla is indigenous in the woods; but though a useful and valuable plant, no attention has been paid to its culture or commerce in this island. In the country round the bay of Sanata, the malagueta, or paradise plant, grows in great abundance; as it is a native of the East Indies, it is thought to have been introduced by Columbus, who frequented this bay more than most other parts of the island; the Spaniards use it to season their most favourite dishes. The tobacco of St Domingo, according to Valverde, has a larger leaf than on any other part of the continent of America; and in quality is equal to that of Cuba or the Havannas; it is found in most parts of the island, but it is cultivated to the greatest extent, and with the most care, in the districts of La Vega and Santiago: by the manufacturers of Seville it is in great esteem, and for segars, it is preferred by them to all other kinds. Two crops of rice are annually gathered; but this crop is not so abundant or productive in St Domingo as in Porto Rico. The natives manufacture hammocks of the fibres of the leaf of the *peta*, a species of abaca. This tree grows in every part of the island, but particularly in Santiago. The flowers are exceedingly numerous, and some of them particularly distinguished by the brilliancy of their colours, and the fragrance of their smell; the most singular, or the most valuable of the fruits, are the vegetable narrow, melon, guava, pine apple, mango, &c.

Of the four species of quadrupeds which were found indigenous on the island on its first discovery, the *hutia*, or agouti cat, only remains. It is of a grey colour, and in form something between the squirrel and the rabbit: it burrows in hollow trees; but when pursued, takes refuge in the depth of the forests. Though assisted by its tail in climbing the trees, or in springing from one tree to another, it is not nearly so nimble as the squirrel: even this animal is nearly extinct in Domingo, being found only in Santiago. All the other quadrupeds were introduced by the Europeans, and they have increased greatly, especially cattle, hogs, sheep, goats, horses, mules, and asses. There are graziers in the district of Seibo, who keep upwards of 12,000 head of cattle, which they sell in herds at six and eight dollars per head; and when the census of the Spanish division was taken in 1780, 200,000 head of cattle were returned; so that the number then, making allowance for those which did not pay the tribute, could not be fewer than 250,000. It is probable, however, that, in consequence of the unsettled state of the island since that time, the number is not now nearly so great. According to Walton, the whole of the cattle in the island do not exceed 300,000; the horses, mules, and asses, he estimates at 150,000. The island abounds in birds, curious for their plumage or song: among these are the flamingo, wild peacock, Jamaica nightingale or mocking-bird, and the banana bird. Among the amphibians and fishes, are the turtle, caro-
The manufactures and commerce of the Spanish division are very much neglected. There are but 22 sugar manufactories of any consequence; and the negroes employed in them do not exceed 600. Of these manufactories, six produce syrup, and some sugar; but the others, which are called \textit{trypicles}, where animals are employed to turn the mills, which press the canes, make nothing but syrup. All the produce is consumed in the colony, except small quantities, which are sometimes sent to Porto Rico or Old Spain. The number of men organized as a militia, amounts to about 8000; but if the militia laws were carried regularly and fully into effect, the number would be raised to 12,000.

In 1726, the French division contained 100,000 negro slaves, and 30,000 white colonists. At that time its greatest commerce was tobacco, with which, from 60 to 100 vessels were laden annually. Immediately before the commencement of the Revolution, according to Mr. Edwards, the population amounted to 30,831 whites, and about 480,000 negro slaves, the mulattoes or free people of colour being estimated at 34,000, but according to Alcedo, at this period the population consisted of 42,000 white people, 44,000 free people of colour, and 600,000 slaves. The number of deaths during 1789, according to the bills of mortality, was 7121; the number of births the same year, 4232. This great excess of deaths is accounted for by the fact, that, in the two years immediately preceding, 60,000 negroes had been imported into the colony. The merchandise landed in the various ports of France from the island of St Domingo in the year 1789 was as follows: 84,617,328 pounds of coffee, 217,463 casks of sugar, white and brown, 5836 casks of molasses, 3,257,610 pounds of indigo, 1,556,017 pounds of cocoa, 11,317,226 pounds of cotton wool, 1514 scorns of Spanish cochineal, 6914 scorns of logwood, fustic, Nicaragua wood, and lignum vitae, 1685 tons of mahogany, 4018 bags of black pepper, 2426 bags of ginger, 380 casks of gunnison and other gums, 248 boxes of aloes, cassis, and... Chicle, 26,948 h des tanned, 114,659 hides in the hair; from the Spaniards, 4107 pounds of tortoise shell, 27,812 barrels of syrup, 1946 boxes of sweetmeats, 1478 scorns of Jesuits bark, 2,617,493 dollars, 57,518 ounces of gold in grains from the Spaniards; the total value of these products was estimated at L.6,094,230. According to Mr Edwards, the average exports before the revolution consisted of 58,642,214 pounds of clayed sugar, 86,549,829 pounds of Muscovado, 71,663,187 pounds of coffee, 6,698,858 pounds of cotton, 951,607 hogheads of indigo, 23,061 hogheads of molasses, 2600 hogheads of an inferior kind of rum called \textit{tafia}, 6500 raw hides, and 7700 tanned ones, the value of which exports was equal to L.4,765,129. In the same year, 710 vessels navigated by 18,460 seamen, and admeasuring 213,540 tons, sailed from Bordeaux, Nantes, Marseilles, and other ports in France, for St Domingo; their cargoes consisted of a great variety of articles, amongst which were French linens, car-

Exports to
France.

Exports before the
revolution.

Imports from
France to
St Domingo in
1789, amounted to
L.4,125,610. At
this time, a very considerable trade was carried on
between the French colony and the Spanish settlements
in the island, in the other islands, and on the main,
the Spanish ships which arrived amounted to 283,
most of which brought dollars and other articles to
the amount of L.2,450,115, to purchase European goods,
slaves, &c. Most part of this trade was contraband.
The import of slaves into French Domingo in 1789 was not inferior to what it had been in the preceding years; the numbers being 35,263. There were brought in 119 large ships, navigated by 415 seamen. From the Spanish part of the island, there was, on an average, annually smuggled into the French division 25,000 horned cattle, and 2000 mules and horses; but as the value of these goods was not nearly equal to the value of the negroes, &c., which the Spaniards obtained, it is supposed that nearly $300,000 in cash were annually sent to make up the balance. There was also a considerable trade between the United States and French St Domingo. In 1789, 684 vessels from America, on an average measuring 70 tons, arrived in the French ports of St Domingo. Their cargoes consisted principally of provisions, East India goods, English manufactures, and lumber; and they took back the various productions of the island. The annual returns were estimated at eight and nine hundred thousand pounds.

Of the commerce of this island subsequently to this period, few authentic particulars are known. From the year 1804 to 1808, according to Mr Walton, "75 vessels, on an average, annually visited her ports with small cargoes, in all amounting to the value of about L150,000 sterling, which they laid out chiefly in wood." Silesian and English goods were imported by the Danes, and provisions, wine, and lumber by the Americans. The author last quoted is of opinion, that this island is capable of furnishing annually 10,000 logs of mahogany, each containing on an average 300 feet, 500 tons of lignum vitae, 500 tons of hickory, 400 tons of logwood, nearly 1,000,000 pounds of coffee, 10,000 hides, besides cotton, indigo, &c.; and he reckons the annual amount of duties which St Domingo productions pay in England in war time, at the sum of L45,000. By a commercial treaty between Major General Carmichael and the governor of the Spanish part of the island, executed in August 1809, all vessels bearing the British flag, are to pay the same duties as Spanish vessels, by which regulation, the import duties will not exceed 5 per cent. and the export duties 6 per cent.

The Spaniards held undisturbed possession of the whole island of St Domingo for upwards of 120 years. About the middle of the 16th century, a number of French Buccaneers, most of them natives of Normandy, settled on Tortuga, a small island lying to the north of St Domingo. From this place they made constant incursions against the Spanish settlements, till at last, by the treaty of Ryswick, that part of the island in which they had established themselves, was ceded to the French king, who had acknowledged them as his subjects, and taken them under his protection. No other event of importance occurred in the history of the island, except the attempt made upon it by Admiral Pen, which has been already noticed, and a dreadful mortality, occasioned by the measles and small-pox, in the year 1666, which is still remembered by the appellation of La Tragedia de los seis, the tragedy of the sixes. When the French revolution began to assume its wild and violent character, the immediate and unprepared freedom of the slaves in their West India islands was one of its first measures. The consequences in St Domingo were most dreadful; the slaves rose and massacred the whites, and in a very short time, the French division was rendered desolate and barbarous, and all the white families who had lived in their power emigrated. The English wished to take advantage of these disturbances; but after the loss of an immense number of their troops, principally by the dreadful unhealthiness of the climate, they were obliged to evacuate it. In 1795, the Spanish government ceased to protect the island, and on the 18th of the 9th of the year 1801, when the black general Toussaint, who commanded the troops of that nation, fixed his brother Paul in the command of it. But the real power of the French in the island was very trifling; and to restore this power, one of the first acts of Bonaparte, after the peace of Amiens, was to send out a very large army under the command of General Le Clerc. This expedition was, in the highest degree, disgraceful and disastrous. By an act of the greatest duplicity, Toussaint indeed was removed out of the way; but the French troops, after being repeatedly defeated, and losing an immense number of men, were compelled to evacuate the island, with the exception of a very small force which withdrew to the city of Domingo. The blacks now formed themselves into a regular government, and their chief Dessalines assumed the supreme authority. He was of a most ferocious disposition; and having exercised his cruelty upon his subjects, as well as upon such whites as fell into his power, he was put to death by the former. The empire of Haiti, (for so it was denominated) was dispossessed by many chiefs after the death of Dessalines. The most celebrated and successful were Petion and Christophe; the former held possession of the southern part of the island, and Christophe of the north. Obstinate and bloody wars have taken place between them; but the population under Christophe is the most numerous. His troops amount to 10,000 men, and is possessed of superior talents and good decision of character. At the commencement of the Spanish revolution, hostilities broke out between the Spanish inhabitants and the French troops who were in that division of the island. The latter being defeated, took refuge in the city of St Domingo, but they were obliged to capitulate and evacuate the island, in consequence of General Carmichael, with a considerable body of British forces, joining the Spaniards in the summer of 1809. (w. s.)

DOMINGO, St, the capital of the island, is in the division belonging to the Spaniards. It lies in 18° 28' North Latitude, and in 69° 50' West Longitude, on the west bank of the Ozama. It was founded by Columbus in 1494, and received its name either because it arrived in the island on a Sunday, or in honour of his father. It was originally built on the east side of the river, but a great part of it having been destroyed by a violent hurricane in 1502, and this calamity being followed by a pestilential visitation of destructive ants in 1504, it was removed to its present site. The port, though only fit for small vessels, is convenient and safe, and contains a natural basin, in which a great number of vessels may anchor. The form of the city is that of a trapezium of about 340 fathoms on the east side along the river, nearly 500 fathoms on the south side bordering on the sea, and about 1800 fathoms in circumference. The streets are straight and broad, crossing one another at right angles; ten of them run from north to south, and two from east to west. The whole city is surrounded by a rampart 8 feet in diameter, and about 10 feet high; the fortifications, however, are not strong, and is completely commanded by some adjoining heights. The appearance of the town is represented as picturesque, but rather gloomy, by reason of the massive piles of buildings, unadorned with steeples; but the gardens interspersed among the houses relieve this effect, and give it a romantic air. The most ancient buildings are built of a species of marble found in the
DOM

DOMINICA, an island of the West Indies, was discovered by Christopher Columbus, on November 3, 1493, and received from him its name, from the circumstance of its having been discovered on a Sunday.

This island is about 29 miles long, and 16 broad. It is divided into 10 parishes, and contains 186,436 acres of land. It contains many lofty and rugged mountains, separated by tolerably fertile valleys, which are watered by about 30 rivers, and a great number of rivulets. Hot springs are found in various parts of the mountainous country, and there are several unextinguished volcanoes, which often throw out quantities of burning sulphur. In the interior of the island, the soil, which resembles that of Martinique and Guadaloupe, is a light brown mould, formed by the detritus of the mountains; but in the valleys, and towards the coasts, it is a black rich earth, well fitted for raising every article of colonial produce. The principal productions of the island are sugar, coffee, cacao, indigo, and ginger. The number of sugar plantations does not greatly exceed 50, and the annual produce is about 3000 hogheads. The coffee plantations are about 200 in number, and in favourable years raise about three millions of pounds weight of coffee. The cacao, indigo, and ginger, are cultivated only in small quantities.

The following is a statement of the exports from the island, during the year between January 5th 1787, and January 5th 1788:

<table>
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<th>Article</th>
<th>Great Britain</th>
<th>British colonial colonies</th>
<th>United States</th>
<th>Great Britain</th>
<th>British colonial colonies</th>
<th>United States</th>
<th>Great Britain</th>
<th>British colonial colonies</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td>71,509 cwt.</td>
<td></td>
<td></td>
<td>69,617 cwt.</td>
<td></td>
<td></td>
<td>70,125 cwt.</td>
<td></td>
<td>68,309 cwt.</td>
</tr>
<tr>
<td>Rum</td>
<td>68,309 cwt.</td>
<td></td>
<td></td>
<td>16,803 cwt.</td>
<td></td>
<td></td>
<td>16,803 cwt.</td>
<td></td>
<td>16,803 cwt.</td>
</tr>
<tr>
<td>Molasses</td>
<td>1,194 cwt.</td>
<td></td>
<td></td>
<td>1,194 cwt.</td>
<td></td>
<td></td>
<td>1,194 cwt.</td>
<td></td>
<td>1,194 cwt.</td>
</tr>
<tr>
<td>Coffee</td>
<td>18,149 cwt.</td>
<td></td>
<td></td>
<td>11,250 lb.</td>
<td></td>
<td></td>
<td>11,250 lb.</td>
<td></td>
<td>11,250 lb.</td>
</tr>
<tr>
<td>Indigo</td>
<td>970,816 lb.</td>
<td></td>
<td></td>
<td>161 cwt.</td>
<td></td>
<td></td>
<td>161 cwt.</td>
<td></td>
<td>161 cwt.</td>
</tr>
<tr>
<td>Hides, dyewoods, &amp;c.</td>
<td>L.11,912 10 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The value of the whole of these articles, according to the current prices in London, was L. 502,987, 15.

The following Table contains the Articles imported into Dominica in the years 1804, 1805, and 1806.

<table>
<thead>
<tr>
<th>Articles Importe</th>
<th>1804.</th>
<th>1805.</th>
<th>1806.</th>
<th>1807.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn, Barrels</td>
<td>6642</td>
<td>8542</td>
<td>10144</td>
<td>10240</td>
</tr>
<tr>
<td>Bread flour, meal, Bar. Qnt.</td>
<td>45</td>
<td>165</td>
<td>175</td>
<td>220</td>
</tr>
<tr>
<td>Rice in barrels</td>
<td>2554</td>
<td>2,589</td>
<td>1,161</td>
<td>1,033</td>
</tr>
<tr>
<td>Beef and pork in Bar. Qnt.</td>
<td>60</td>
<td>1011,355</td>
<td>3653</td>
<td>0 22</td>
</tr>
<tr>
<td>Dry fish, Barrels</td>
<td>685</td>
<td>0</td>
<td>515</td>
<td>702</td>
</tr>
<tr>
<td>Pickled fish, Firkins</td>
<td>46</td>
<td>224</td>
<td>8</td>
<td>631</td>
</tr>
<tr>
<td>Butter, 3648</td>
<td>1040</td>
<td>3174</td>
<td>176</td>
<td>2396</td>
</tr>
<tr>
<td>Cows and oxen, 235</td>
<td>323</td>
<td>122</td>
<td>416</td>
<td>389</td>
</tr>
<tr>
<td>Sheep and hogs, 461</td>
<td>14000</td>
<td>2631,800</td>
<td>104,000</td>
<td>2254,500</td>
</tr>
<tr>
<td>Oak and pine boards and timber, Feet</td>
<td>3000</td>
<td>2098,675</td>
<td>174,459</td>
<td>1502,300</td>
</tr>
<tr>
<td>Shingles, No.</td>
<td>12,840</td>
<td>293,000</td>
<td>6,450</td>
<td>265,000</td>
</tr>
<tr>
<td>Staves, No.</td>
<td>12,840</td>
<td>293,000</td>
<td>6,450</td>
<td>265,000</td>
</tr>
</tbody>
</table>

* Thirty-seven cows were imported from other countries in 1804, and 127 in 1806.
In the year 1732, Dominica contained 938 Caribs, and 849 French occupied the part of the coast which had been abandoned by the natives, and which they cultivated by the aid of 23 free mulattoes, and 293 slaves. At the peace of 1763, the island contained 600 whites, and 2000 blacks; and, in 1788, the population consisted of

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Whites</td>
<td>1,236</td>
</tr>
<tr>
<td>Free Negroes</td>
<td>445</td>
</tr>
<tr>
<td>Slaves</td>
<td>14,967</td>
</tr>
</tbody>
</table>

Total population 16,648

There are still about 20 or 30 families of the aboriginal inhabitants, who are industrious and inoffensive. They are of a clear copper colour, with long sleek black hair, and are short, stout, and well made. They subsist chiefly by fishing, and by shooting with the bow and arrow.

The principal towns in the island are Portsmouth and Roseau, or Charlotte’s town.

At the peace of 1763, Dominica was confirmed in the possession of the English, who had subdued it in 1759. In 1778, it was taken after an obstinate resistance, by the French, under the Marquis de Bouillé, governor of Martinico, and, after continuing in their possession for more than five years, it was restored to England by the peace of 1783.

In 1803, a formidable French squadron made a descent upon the island, and burned the capital, Roseau; but the island was preserved to Great Britain by the skilful management of Sir George Prevost.

The position of Roseau, the capital, according to solar observations, is in West Long. 61° 32' 15", North Lat. 15° 18' 29". (π)

DOMINICAL LETTER. See Chronology, p. 409.

DOMITIAN, one of the Emperors of Rome, and the last of the twelve Caesars, was the second son of Vespasian, and was born at Rome on the 24th of October, A. D. 51. He bore the name of Titus, Flavius, Sabinus Dominianus; and appears to have spent his youth in idleness, indifference, and vice. When his father Vespasian was contesting the empire with Vitellius, he retired with his uncle Sabinus to the Capitol, where he made a narrow escape by concealing himself in an apartment of the temple, and secretly withdrawing to the house of a friend. Upon the death of Vitellius, A. D. 69, when Vespasian was still in Judea, Domitian was proclaimed Cesar at Rome; and continued, during his father’s absence, to bear the chief sway. His first appearances in the senate were modest and prepossessing, and his first acts of government were conciliatory and popular; but he soon abandoned himself to the pursuit of his pleasures, and employed his power only for the gratification of his vicious inclinations. Ambitious at the same time that he was dissolute, he pretended to usurp every kind of authority; and, in one day, bestowed so great a number of offices, both in the city and the provinces, that his father is said to have written in one of his letters, “I thank you for not having yet sent me a successor, and for your kindness in vouchsafing to let me enjoy the empire.” Jealous of the fame which his brother Titus had acquired in the Jewish war, he resolved to take the command against Civilis in Gaul, and had actually reached Lyons with that design; but was persuaded by Mucian, who knew his inexperience in military affairs, to content himself with making a display of his princely power in that city. During his residence in that quarter, he secretly endeavoured to corrupt the fidelity of Cerealis, who then commanded in Gaul, either for the purpose of making war upon his father, or forming a party against his brother; but the general evaded all his proposals, and treated them as nothing more than childish fancies. Disappointed in his plans of revolt, he had resolved to dissemble his ambitious schemes, relinquished all the functions of government, renounced even the natural prerogatives of his rank; and, burying himself in solitude, pretended a great zeal for learning, and particularly applied himself to the composition of verses.

With all this affected fondness for retirement, he made frequent applications for a military command; but his father, well acquainted with his disposition and designs, invariably declined entrusting him with an army. At the death of Vespasian, he manifested a disposition to dispute the succession with his brother Titus; pretended, that it was the will of his father, that they should jointly inherit the empire; and even proceeded so far as secretly to solicit the troops to revolt. But, his courage failing him, or his attempts proving ineffectual, he continued during the reign of Titus without any other title, but that of Cesar, a prince of the Roman youth, except that his brother, who always treated him with civility and kindness, made him his colleague in the consulsip. As soon as Titus expired A. D. 81, Domitian hastened to Rome; and promising to the pretorian guards the usual donation, was immediately saluted emperor, in the 30th year of his age. The commencement of his reign was highly auspicious; and he gained the affections of the people by conduct truly worthy of a great monarch. He was assiduous and impartial in the administration of justice; punished, with the utmost severity, all those judges who were convicted of taking bribes; and kept the magistrates of cities and provinces strictly within the bounds of legal authority. He enacted various useful laws for the reformation of manners, the prevention of libels, the regulation of the theatres, &c. He displayed the greatest munificence in presenting large sums to his officers, in order to raise them above the temptation of accumulating wealth by unwarrantable means; in refusing to accept estates which were left to him by those who had children of their own; in forgiving all debts above five years standing due to the treasury; in augmenting the pay of the soldiers, and completing the public works which had been begun by Titus. Even amidst these more commendable transactions, however, he displayed the most consummate vanity, and puerile ostentation; causing himself to be appointed consul ten years successively, doubling the number of lictors that were carried before him, appearing always in the senate in his triumphal dress, continually proclaiming himself "Imperator," or vicarius general, though his armies were generally sustaining defeats; filling every corner of Rome with triumphal arches in honour of his pretended victories, crowning the temples with statues of himself, which he required to be either of gold or silver, and always of a certain height; and continually amassing himself with the most expensive shows and extravagant entertainments. At a very early period, also, he began to give indications of his cold-blooded cruelty; and it is affirmed by some ancient authors, that even while he was professing the most exalted sentiments of humanity, and proposing to forbid the offering of any living creature in sacrifice, he used daily to retire to his apartment to amuse himself with catching flies, and trans-
fortune, he was suspected, and his anxiety for his safety was increased by the approach of the tyrant, whose bloodthirsty vengeance was naturally excited by the jealousy and dread of the tyrant, was sure to be either put to death, or to be deprived of all honour and command. Of this, a striking instance occurred in the fate of the celebrated Agricola, whose successes in Britain were followed by his recall from that province, his dismissal from all military employment, his subjection to the emperor's daily distrust, and finally, it is suspected, by an unfair death.

His principal amusement consisted in the shows of the amphitheatre, which he conducted with the utmost profligacy of expence, and refinement of cruelty. He procured females to run in the circus, and fight like gladiators. He caused an immense lake to be dug near the Tiber, in which he exhibited sea-fights; and frequently prolonged these diversions through the whole night by the light of the moon or of torches. In order to fill his treasury, when exhausted by these extravagant expences, he had recourse to every kind of rapine, extortion, and infamous confiscations; seizing, upon the slightest pretence, the estates of the wealthier citizens, and reducing to beggary the most opulent families throughout the empire. Nor was he more sparing of the lives than of the fortunes of his subjects; and while he plundered those whose riches he coveted, he cut off others whose virtues he dreaded. He commanded the astrologers to cast the nativities of the most illustrious persons in the city, and put to death all those who were pointed out as destined to attain an empire. He accused the knights and senators of treason upon the most trifling grounds, and either procured them to be condemned by the senate, or commanded them to become their own executioners. In the event of any conspiracy or insurrection, he tortured and butchered whomsoever he pleased, by charging them as accomplices. Many of the most virtuous characters he coolly put to death, for no other reason than because their exemplary lives seemed to reproach his debaucheries, and to demonstrate their disapprobation of his conduct. He is said to have taken an inhuman pleasure in beholding the sufferings which he inflicted; and to have delighted in exciting the terrors of those whom he spared. At an entertainment, as described by Dio Cassius, to which he had invited the principal senators and knights, the guests were conducted into a spacious hall, hung round with black, and lighted only by a few melanichol lamps, so as to discover a range of coffins, upon which were inscribed the names of those who were invited. While they were looking in consternation upon this gloomy spectacle, and momentar­ily expecting the doors which had been bolted, the doors suddenly burst open, and they were surrounded by a crowd of naked figures, whose bodies were painted black, holding naked swords in the one hand, and flaming torches in the other. Having beheld these supposed executioners dancing around them for some time, and been made to experience in imagination all the horrors of a violent death, the doors were again opened, and they were permitted to withdraw.

As some of those whom he sacrificed had professed the philosophy of the Stoics, he banished from Rome and Italy all philosophers and teachers of the liberal arts, and commanded many of their writings to be publicly burned. In the 14th year of his reign, A.D. 95, he proceeded to fill the measure of his crimes by a cruel persecution of the Christians, whom he ordered to be treated in every quarter of the empire as declared enemies of the state; all multitudes of whom were either condemned to banishment, or punished with death. Among the noble sufferers in this proscription, may be mentioned the emperor's own cousin-german, Flavius Clemens, and his wife Flavia Domitilla. The apostle John is understood to have been at the same period banished to the Isle of Patmos, where he wrote the Apocalypse. Long before the commencement of this persecution, Domitian had gone so far in his madness, as to declare himself a god, and to require divine honours to be paid to him. But, with all his pretended divinity and sanguinary precautions, he was perpetually harassed with the apprehension of assassination, which was still further increased by certain prodigies and predictions which preceded his death. Hence he became suspicious of his most intimate friends and nearest relatives; and this distrust of his own family only rendered it the more necessary for them to consult their own safety by hastening his end. It is said, that his wife Domitia, having found a paper which a child had taken from the emperor's pillow, and which contained a list of several persons destined for slaughter, with her own at the head of them, immediately formed a conspiracy against his life with the other devoted objects of his suspicion. As if possessed with a presentiment of his approaching fate, the tyrant became doubly circumspect; and among other precautions, is said to have caused the gallery in which he usually walked to be lined with a polished stone, which reflected objects like a looking glass, that he might readily perceive what was doing on every side of him. On the day of his death, as he was going to bathe before dinner, his chamberlain, Parthenius, introduced to him Stephanus, the steward of the banished Domitia, a man of great strength, who bad undertaken to dispatch the tyrant. Having his arm in a sling, as if it had been hurt, he the more easily concealed a dagger; and while the emperor was attentively reading a memorial which he had presented relating to some alleged conspiracy, he plunged the weapon in his belly. Notwithstanding his wound, Domitian struggled for some time with Stephanus, and even succeeded in throwing him to the ground, when the other conspirators, entering the apartment, speedily dispatched him with many wounds. Some officers of his guard, who were not privy to the plot, alarmed by the noise, hastened to the spot, and put Stephanus to death; but the other conspirators had succeeded in making their escape. Thus perished, in the 43d year of his age, and after a reign of 15 years, the most detestable tyrant that ever oppressed the Roman world. The soldiers, whose pay he had increased, and who had frequently shared his banquets, were the only persons among his subjects who regretted his death, and wished to take vengeance upon his murderers. The senators, on the contrary, publicly expressed their joy, and loaded his memory with the bitterest invectives. They ordered all the pictures, statues, and other representations of him, to
DON, the Tanais of the ancients, and the Tuna of the Tartars, is one of the largest rivers in Europe, and the second in magnitude of those which discharge themselves into the Sea of Azof. It rises in the Ivanofskoy Lake, not far from Tula, in the government of Rezan; and after watering a considerable extent of country, it divides into three branches at the town of Tscherschkoy, and discharges itself into the Sea of Azof, where it is so shallow that only flat-bottomed vessels can pass into the sea. The course of this river, exclusive of its windings, is about 1000 vers. It flows in general through a flat country, covered with immense forests of pines and oaks. Its bed is commonly sand, marl, and lime.

In one part of its course, the Don approaches so near to the Volga, that Peter 1. was extremely anxious to form a junction between these two rivers. He himself discovered two practicable tracks. One of these was from the Lower Volga, by uniting the rivulets Kami-shinka and Ilgafa with a canal of four vers. This plan was actually begun, but was abandoned from an insufficiency of water. The reservoirs, which were intended to have been placed at the sources of the Kami-shinka, were scarcely capable of supplying the common stream of the river. The other plan was to unite the source of the Don 25 vers. from the town of Chepishan, with the rivulet Kala, which falls into the Oupa, one of the principal branches of the Oka, which runs into the Volga. This plan was likewise begun, and a considerable part of it carried into effect. Twenty-four sluices of limestone were built, and the canal cut through the extent of the vale of Bobriky, corresponding to the depth of the bed of the Don; but it was abandoned from a supposed want of water.

The rivers which fall into the Don are the Danets, which rises a little above the town of Belgorod, and is generally navigable, particularly in spring, receiving the rivers Eyedor, Koren, and Orkole, which are small and little frequented; the Voronege, which is navigable only in spring; the Bolutzor; the Derkul; the Kalitva; the Somsa, which is generally navigable, and receives the Ostrogosa; and the Choper, which rises from a morass in the province of Penza, and has a course of 360 vers., through a fruitful country, abounding in corn, wood, and pasture. The Choper is navigable through the district of Choperskoy, particularly in spring, and receives the rivers Verona, Kolitkey, Gamala, Milkarey, Arkadak, Karay, Serloba, Ilgafa, and the Medvitsa. See Tooko's View of the Russian Empire; and Clarke's Travels, vol. i. passim. (x)

DONAGHADEE, a maritime and port town of Ireland, in the county of Down, and province of Ulster, situated upon that part of the Irish Channel which separates Scotland from Ireland. The town consists of two principal streets. One of these is open and exposed to the sea; and the other, situated behind the first, is well roamed. The communication between Scotland and Ireland is from Donaghadee to Portpatrick in Scotland, the distance between which is about 25 miles. The quay is formed in the shape of a crescent, and consists of large stones; without any cement. It is 128 yards long, and 22 feet broad, and has a breast wall of the same stones about 6 feet broad. Distance from Dublin 914 miles, and 15 from Belfast. (f)

DONATIA, a genus of plants of the class Triandria, and order Trigynia. See Botany, p. 110.

DONAUHEBENGEN. See Danube.

DONAX. See Convolvulus.

DONCASTER, a large and beautiful market town of England, in the West Riding of Yorkshire, and on the south division of the Wapentake of Strafforth and Tickhill. It is pleasantly situated on the south side of the river Don, on a narrow tongue of land bounded by the Don on the north, and a range of fens or marshes, called Potteric Car on the south. The principal street, which in different parts of its length has the name of Hall-gate, High-street, French-gate, and Marsh-gate, forms one line, and is part of the great north road from London to Edinburgh. It is nearly a mile in length from the Hall Cross on the south-east, to the Mill Bridge on the north-west. The street, which runs from the north-east extremity of the town to the west end of St Sepulchre's gate, in the direction of the road to Rotherham and Sheffield, is above half a mile long. Several new streets have recently been laid out on the east side of St Sepulchre's gate, and many elegant houses are already erected.

The parish church of St George is situated near the river, on the site of an ancient castle, and appears to have been built at different periods. A stone bearing the date of 1071 was lately taken out of the wall at the east end. The church is 154 feet long, 78 feet high, and 68 feet broad. It has eight bells, an excellent organ, and a good library. The tower, which is 141 feet high, appears to have been built in the reign of Henry III. There is also in Doncaster a number of other places of worship, viz. a Presbyterian chapel, the Methodist chapel, an elegant chapel belonging to the Independents, a meeting-house for the Society of Friends, and another for the followers of Joanna Southcote.

The charitable institutions are, a public dispensary, erected in 1792, and supported by voluntary contributions; St Thomas's hospital, established in the 50th year of Queen Elizabeth, for six decayed housekeepers of good character; a workhouse for the employment of the poor; a school of industry; and several Sunday schools.

The mansion-house is a very magnificent building. It is in the centre of the town, and was erected in 1744, and enlarged and thoroughly repaired in 1800.

The town-hall, where public business is transacted, was repaired in 1782; and affords room in its lower apartments for the free grammar-school. An English school has also been established by the corporation, and there is likewise a good theatre.

Several unsuccessful attempts have been made to establish manufactures in this place. The only one which is at present carried on, is one of machines for cutting straw and splitting beans, and invented by Mr Thomas Pasmore. It is carried on under the firm of Pasmore, Jenkinson, Pearson, & Co. and has met with great success.

The markets of Doncaster are well supplied. The sheds, built in 1756, are covered with a slated roof, and supported by 24 columns. The butter cross is a building of an octagonal form, supported by pillars. The fish market, the vegetable market, and the pottery ware market, are held in a large square called the Market. The corn market, where a great quantity of
grain is sold, is held in a spacious area farther to the north. The two annual fairs are kept on the 5th of April and the 5th of August, for horned cattle, sheep, horses, and coarse woollen cloth.

The corporation of Doncaster possesses an annual revenue of L.7000, which has always been munificently expended, for promoting the prosperity of the town, and the comfort of its inhabitants. The corporation consists of a mayor, a recorder, a town-clerk, twelve aldermen, and 24 common councillors.

As Doncaster contains a great number of opulent families, and of genteel families of small fortune who have selected it as a desirable and cheap place of residence, the means of education are numerous. There are no fewer than eleven large boarding-schools for youth of both sexes.

The race-ground of Doncaster, and the great stand for the accommodation of the company, are the finest in the kingdom. The race-ground is enclosed by a beautiful railing; and the races are among the finest and the best attended in the country.

Doncaster was a Roman station, and is the Dumum of Antoninus, the Caesar-dunum of Nennius, the Dona-cereum of the Saxons, and the Doncaster of the Scots. For a particular account of its history and antiquities, we must refer the reader to Miller's History of Doncaster.

The following is an abstract of the population return for the borough of Doncaster, for 1811.

Number of inhabited houses. 1438
Number of families that occupy them. 1557
Houses building. 28
Uninhabited houses. 42
Families employed in agriculture. 173
Do. in trade, manufactures, &c. 833
Do. not comprised in these classes. 551
Number of males. 3110
Number of females. 3825
Total population in 1811. 6935
Do. in 1801. 5697
Increase since 1801. 1238

See Miller's History of Doncaster and its Vicinity, Doncaster, 1804, which is a very valuable work; and Bigland's Beauties of England and Wales, vol. xi. p. 519, &c. (\*)

DONDRA HEAD, or DONDRE HEAD, called by the natives Dewallum, Dewander Head, or Devi-noor, is the most southern extremity of the Island of Ceylon. It is a low point, having a grove of tall cocoa nut trees on its extremity. The populous village of Dondra, in its neighbourhood, was at one time a place of great note, and was much frequented on account of a magnificent Hindoo temple in its vicinity, which is now in ruins. The fort of Matura was built by the Portuguese and Dutch from the stones of that edifice. Another temple much resorted to by the Cingalese, still exists. It is about 12 feet high, and 150 in circuit. A bell-shaped stone rises from the centre, so as to make the whole height about 30 feet. A full account of this edifice will be found in Perceval's Account of Ceylon, p. 155.

Dondra Head is situated in 80° 43' of East Long. and 5° 53' of North Lat. (\*)

DONEGAL, a county of Ireland, and the largest in the province of Ulster. It formerly went under the name of Tyrconnell; and was a separate principality, with powerful chieftains over it, so late as the time of Queen Elizabeth. It is situated on the northwest extremity of the island; and is bounded by Londonderry and Tyrone on the east, by Fermanagh on the south, and by the Atlantic Ocean on the north and west. Its general aspect is bleak and forbidding. Though its shores are finely indented by the sea, though it has many rivers, and much hilly ground, yet it presents little either of grand or of beautiful scenery. With the exception of a few spots, in which taste and enterprise have combined to supply the want of local advantages, or to improve those which already existed, there is nothing to gratify a traveller's eye. Nature has not been liberal, and art has been almost wholly idle. The most attractive scenes and prospects are those at Brownhall, near Ballyshannon; Donegal bay, and the bridge of Inver in its neighbourhood; Woodhill; the approach to Major Nesbit's of Glentis; Hornhead, where there is a remarkable cavern; the Ards, the seat of Mr Stewart; Mount Alt, from the summit of which the views are truly magnificent; Ramelton, near which is the residence of Sir James Stewart; the Bishop of Derry's seat at Faun, in the barony of Finisheen, from which the views of Lough Swilly are exceedingly grand.

This county, with respect to soil, is, upon the whole, remarkably unfavourable for the cultivation of every kind. It is cold, rainy, and tempestuous.

From the nature of the soil and the climate, agriculture cannot be supposed to be in a flourishing state. And when, besides these untoward circumstances, it is recollected that the farmers are poor and unskilful, that they have no proper stimulus to exertion, and no encouragement from the proprietors, almost all of whom are non-resident, it is easy to believe that the husbandry of Donegal is wretched and unproductive. To this general remark there are some pleasing exceptions; and in certain quarters, for instance in the neighbourhood of Raphoe, great improvements have lately taken place. Hills, and the steep sides of mountains, which formerly produced nothing, are beginning to be covered with oats, potatoes, and flax. The most improved part of the country is the part adjoining Tyrone, where there is a district about 17 miles long and nine miles broad, with a good soil under tolerable management, and yielding crops proportionate to these advantages. Still, however, the great proportion of the land is either not cultivated at all, or cultivated in the most slovenly way.-Very little wheat is grown in this country. Some peas are to be seen; but the great quantity of rain that falls renders this a precarious and unprofitable crop. Barley is cultivated all along the coast, and forms a regular branch in the rotation. Oats, potatoes, and flax, also are raised to a considerable extent. Clover is almost unknown. The fiorin grass is approved of by some, but not much used.

In the following Table, the reader will see the average of the seed and produce of different crops:
Donegal.

\[
\begin{array}{ccc}
\text{|
| Crop | Seed used per En. Acre | Produce per English Acre | Proportion between soil and produce.}
\hline
\text{Wheat} | 140 | 1,750 & 1 to 12.5 \\
\text{Barley} | 210 | 2,100 & 1 to 10 \\
\text{Oats} | 280 | 2,240 & 1 to 8 \\
\text{Potatoes} | 1550 | 10,320 & 1 to 11.5 \\
\text{Flax} | 17 | 8 cwt. & 1 to 457 cwt. \\
\end{array}
\]

In 1809, there were supposed to be sown about 6600 acres of flax, from the produce of which there would be saved 7500 bushels of flax seed; and of that, bounty was allowed on 5600 bushels, bringing L. 1400 of bounty, at five shillings per bushel.

The manures used in this county are various. Lime, and limestone gravel, though found in great abundance, are seldom or never employed. Sea sand is made use of. Sea-weed is laid on the ground in which potatoes are to be planted; but it makes them watery and unfit for the table. Dung, of course, is the principal manure. It is not collected, however, with much care, or applied with sufficient skill.

The practice of fencing has made little progress; the chief fences, even in the most cultivated districts, being only grass banks thrown up to mark the boundaries. It is necessary, therefore, for the cattle and sheep to be herded whenever there is any corn; and as soon as the corn is harvested, they roam at large through all the fields.

Tillage is done in many places with the spade. This implement is thought to be best in preparing the ground for potatoes. Potatoes are sometimes planted by means of a dibble or stevens. Besides the common spade, they also make use of the long Leitrim lays, which resembles a tool employed by the land drainers in England. The two horse Irish plough is the plough in ordinary use.

Cattle, sheep, &c.

There are not many cattle produced in this county. Heifers and young bullocks, when 2 or 3 years old, are brought from the mountains, and taken to the Scotch and English markets for feeding. Very few are fattened, even in the most fertile districts. Indeed the pasture is in general very indifferent. And the attention of the people is chiefly occupied with the breeding of milk cows, tillage, and manufactures. There are scarcely any liberties. The sheep are few in number, and extremely bad in kind. On the mountains there are some, which are represented to be as fleet as greyhounds. In the barony of Inishoen, as soon as the corn is carried home, the sheep of the small tenants herd together, and rove about indiscriminately in search of food. There are multitudes of goats here, as in most other parts of Ireland. Rabbits also are found in considerable abundance. On the northern shore there is a warren of some extent, bringing an annual revenue to its proprietor of between five and six hundred pounds.

The average prices of labour, &c. were estimated in 1811 to be as follow: A man the year round L.8, 11s.; a woman, do. L.3, 15s. 6d.; carpenter per day, 2s. 7d.; mason, do. 2s. 10d.; plaster, do. 3s. 3d.; quarryman, do. 2s. 1d.; thresher, do. 1s. 3d.; mason per perch 3s. 5d.; plaster per square 6s. 3d.; bricklayer per perch, 1s. 6d.; car and horse per day 2s. 6d.; saddle horse, do. 3s. 9d.; plough, do. 5s.; grazing a cow per week 1s. 9d.; ditto horse, do. 8s. 10d.; shewing a horse 3s. 2d.; labour in harvest of hay or corn per day 1s.

74d.; mowing grass per acre 5s. 6d.; day labour of children 5d.; fencing per perch 1s. 5d.; blacksmith's work per day 2s. 6d.; ditto per lb. 7d.; line per barrel 1s. 4d.; bricks per thousand L.1, 6s. 4d.; a car mounted L.3, 2s. 9d.; hay per ton L.2, 10s. 10d.; potatoes per stone 3d.; wheat per barrel L.2, 5s. 6d.; prices of articles of food.

The fuel commonly made use of in this county is turf and peat, of which the bogs furnish an ample supply. In some places English coal is burnt. At Ballinasheen, it sells for a guinea and a half per ton. Wood is remarkably scarce. There are extensive tracts of ground, which might be advantageously covered with plantations, but the advantage is almost utterly neglected. It is only about gentlemen's seats, of which there are extremely few, that this improvement has been carried on with any degree of spirit. It is not improbable that the bogs were formerly forests; but at present one may travel many a mile without seeing a single tree, and Mr Wakefield had heard of bodies being burnt in mats, for want of timber to make coffins. Mr Stewart of the Ards is an extensive planter, but complains of want of encouragement. He plants chiefly the oak, the ash, and the birch. He rejects the Scotch fir, as injurious to the other trees.

Clay is found in immense quantities, and of various kinds and colours. On Murkish mountain there is abundance of siliceous sand, which for some time has been sent to the Belfast glass manufactury; and employed there in place of that which used to be obtained from England. In the bay of Ards, it is supplied for L.2, 3s. 6d. per ton. Within a mile of Letterkenny, and half a mile of Lough Swilly, there is an excellent slate quarry. Lead ore is met with. The mine on the estate of Lord Leitrim is extremely rich. There is also iron stone, coal, anthracite, garnets, marble resembling that which is denominated statuary marble, chalcedony, of which one piece was found weighing 74 lb., and very beautiful granite. Limestone is plenty. There is an extensive tract of it near Ballinasheen.

The rents of this country are, on the whole, exceedingly low. Mr Wakefield makes the average rent to be 7s. per acre; and Mr Hamilton is of opinion, that the rent of land fit for the plough is from 10s. to 20s. per acre. The mountains are of such trifling value as to be let in the lump. In the neighbourhood of Ballinasheen, land lets at from 5 to 8 guineas. From Ballinasheen to Halintree the rent is about L.1, 10s. The town parks of Donegal let at L.5, and land without the town at from 15s. to 30s. The common leases given at present are for 21 years and a life; but the greater part of those which were granted formerly, and are not yet expired, were for 61 years and three lives. Lord Conyngham, and Sir James Stewart, grant their leases for 31 years and three lives. Lord Donegal's leases are for 61 years, and he renews them on a fine. Minor pro-
priests, possessing estates of from L.200 to L.1000 per annum, are much wanted. Wherever such incomes are found, they belong only to leaseholders. Village partnerships, so common in the west of Ireland, are also prevalent in this county. They amounted at one time to not fewer than 500; but they are gradually decreasing. In the Ross estate, Lord Conyngham has 30,000 acres of granite mountain, which bring him not more than L.2200 per annum. Lord Donegal has nearly 100,000 acres in Inishoen. Mr Murray, a gentleman resident in Scotland, has L.10,000 per annum. The Marquis of Abercorn L.9000; Lord Leitrim L.9000; and Lord Erne L.5500.

The condition of the inhabitants in general is mean and uncomfortable. In the mountainous districts it is wretched in the extreme. The people there are dirty, ragged, ill fed, and superstitious. Their habitations are miserable and disgusting, and their habits such as distinguish the lowest stage of civilization. On the coast, Mr Wakefield tells us, that he met with a peasantry who appeared to be native Irish, most of them speaking the original language, and many of them not knowing a word of English, or, as they call it, Scotch. The men wear shoes and stockings, but the women go barefooted. They are different from the people in the inland parts. They have better houses, and are cleaner in their persons.

The principal rivers in this county are the Gubbarra, which has a short south-west course, and terminates on the west coast; the Finn, which rises at no great distance from the Gubbarra, and running almost directly east, passes into the county of Tyrone, where it joins the Foyle at Strabane; the Dale, navigable by small boats for a few miles, from the Foyle to the village of Ballindrait; the Swilly, which loses itself in the lough of the same name; the Erne, which flows from Lough Erne, and falls into the sea at Ballyshannon, where it forms a very rapid though not a high cascade; the Leannan, and several other streams of less magnitude.—There are many loughs or lakes in Donegal. The most remarkable is Lough Derg, situated in the midst of mountains, and in the barony of Tyrugh; and this is remarkable principally for its being the scene of a Catholic station. In the centre of the lake, and about a mile from the shore, is an island containing not more than an Irish acre. There is a cavern there called the Cave of St Patrick, or St Patrick's Purgatory. Thither the Catholics resort during the months of June, July, August, and September, to do penance for their sins, or rather perhaps to express their superstitious veneration for the place; and so popular is the pilgrimage, that at no time in the course of that period, are there ever fewer than a thousand or twelve hundred persons assembled on the island, nor is there almost a single adult individual of the Catholic persuasion in the counties of Donegal, Londonderry, Tyrone, and Monaghan, who has not been there at least once in his life. Those who visit it on this occasion, from whatever distance they come, must travel all the way bareheaded and barefooted. They remain nine days and nine nights. They are allowed eight oat cakes each; they sleep in the open air; and drink nothing but water out of the lake. The last twenty-four hours must be spent in fasting, and in the course of this time they all bathe, and crowd to a wretched foveal adjoining the cave, which has the name of a chapel, there to make their confessions, and perform their devotions. The Catholic Bishop of Clogher nominates a priest and six assistant ministers, to aid the penitents in these sacred exercises. The priest receives one shilling from each person on landing, and the assistants are remunerated by those whom they confess. One is employed the whole day saying mass in the Irish language, and the others in taking confessions. The priest and his condivotors have a laborious but a profitable occupation; and while the poor people are starving on cakes and water, they are feasting on fish, meat, porter, and wine.—This county abounds in excellent harbours. The bay of Strabragy, in the barony of Inishoen; Mulroy bay and Sheephaven, in that of Killmacrenan; the Guidore, and the Gubbarra; Killbegs, and the road at the Rosses,—all afford safe and commodious retreats for vessels. Donegal bay, formed by the high land of Tiellen head in this county, and the Stags of Broadhaven in that of Sligo, is very capacious; but Mr Dalrymple, hydrographer to the Admiralty, has found by accurate survey, that it is not so wide by ten miles as it is laid down in the charts. Lough Swilly is an uncommonly fine harbour, being twenty miles long, from two to four broad, and of sufficient depth for the largest ships of war. The entrance to it is between two high cliffs, and, when viewed at a distance, appears so narrow, as to seem capable of being shut by a pair of floods. It would leave the only bay of Great Britain in perfect security at single anchor.

The lakes and rivers in Donegal contain all the common freshwater fish, as trout, salmon, eels, &c. At Ballyshannon, on the Erne, there is a great salmon fishery. It is one of the largest, indeed, in Ireland. It belonged to Admiral Packenham, and in 1808 was let for L.1200. Salmon are killed here, weighing above forty pounds. The river Lenam also abounds with salmon, which, like those of the Bann and the Bryne, are always in season. At Ballyshannon there is an eel fishery, which, some years ago, let for L.925 per annum. A few years ago, the herring fishery was a great and thriving concern on the Donegal coast. It was carried on under the patronage of the Right Honourable Burton Conyngham, who made an establishment for the purpose in Rutland Island, and by whom a village, and all the buildings necessary for selling and curing the fish, were erected at an expense of L.38,000 from himself, and a parliamentary grant of L.20,000. Every thing was done to promote the undertaking; and so successful was it for some time, that it gave employment to 300 vessels and 1200 boats, and that there were returns in cash of no less a sum than L.135,000. But the herring soon disappeared, and the whole scheme failed. The reason of these fish deserting this part of the coast was thought to be the prevalence of a red animalcule, called the Cancer halecun, with which the whole surface of the water seemed to be covered. About thirty years ago, a whale fishery was attempted with considerable success. The gentleman who engaged in it generally killed two or three, and sometimes four in a season. An unfortunate accident, however, happening to one of the boats, which was dashed to pieces by a whale, and had two of its crew drowned, put an end to this enterprise, and it has never since been revived. At the same time, sun-fish, of a monstrous size, and producing each from a ton to a ton and a half of oil, were caught in great numbers. The average value of a whale was about L.750; that of a sun-fish about L.45. Cod and hake also used to be taken in such quantities, that Mr. Brice, in his Report to the Committee on the Irish Fisheries, makes mention of four men having caught with lines twenty dozen of these fish in two
Donegal.

Manufactures, &c.

hours. But of late years, all the fisheries on the coast of Donegal have, from various causes, very much declined.

The chief manufactures in this county are those of linen, duck, and canvass. The linen, of which a considerable quantity is made, is narrow, not exceeding 32 inches in width. Much of the yarn made use of is spun in the adjoining counties of Londonderry, Antrim, and Tyrone. The amount of yarn sold in the monthly yarn market of Donegal is L.1,500; and in the market of Ardra it is not less than L.2,000. In the years 1807 and 1808, the Linen Board paid the sums of L.165 and L.147, 12s. 3d. as bounty at the rate of 2d. per yard on 19,795 yards, and 17,750 yards of duck and canvass.—On the coast at Ards, there is a sea-weed called slaitk-marrow, which grows to an immense size, and is washed up sometimes in ridges, ten feet high and a mile long. This sea-weed is dried, and burnt for kelp ashes, which sell at from 5s. to 15s. per cwt.

There are no towns in this county of any great consequence. The principal one is Ballyshannon, which stands upon the Erne, and has the advantage of a salmon fishery. Lifford, the county town, is but a small place. Letterkenny, though happily situated at the bottom of Lough Swilly, seems not to have profited by that circumstance. Donegal also, notwithstanding its favourable situation on a fine bay, is of very little note. Killibegs, with similar advantages, is equally insignificant. And Raphoe has no other recommendation, than that of being the see and residence of a bishop.

Weights and measures.

The dry measures and weights are Troy and Avoirdupois; and the liquids are pints, &c. as through the rest of Ireland. From Ballybofes to the sea, potatoes are generally sold by a measure, which is supposed to weigh about 8 stone, 14 lb. to the stone. Oaten and barley meal is sometimes sold by the peck, which contains 28 quarts, and is supposed to weigh 8 stone. Selling oats by measure is abolished.

Donegal is divided into five baronies, viz. Inishoen, Kilmacrenan, Raphoe, Boylagh and Bannogha, and Tyrugh. It contains 42 parishes. Along with the burgus of Ballyshannon, Donegal, Killibegs, Lifford, and St. Johnston, it formerly returned 12 members to Parliament. But since the union, it sends only two, and both of them are for the county. There are 9,000 freeholders. Earl Conyngham and the Marquis of Abercorn have freeholders sufficient, when united, to return the members for this county; but Lord Donegal possesses an estate, which enables him, with good management, to succeed against either of them singly.—There is one regiment of militia.

In this county, which is all in the ecclesiastical province of Armagh, the diocese of Raphoe, according to Dr. Beaufort, has 31 parishes, with 32 churches, comprising an area of 515,250 Irish acres; that of Derry has 11 parishes and 13 churches, with an area of 139,300 Irish acres; and that of Clogher has one parish and one church, with an area of 25,000 Irish acres. The bishop of Raphoe has a revenue of L.800.—in the time of Mr. Young, author of the Tour in Ireland, it was only L.260. The whole of his diocese lies in the county of Donegal. It is 56 English miles long and 40 broad. The chapter is composed of the dean, the archdeacon, and four prebendaries. The see is in the small town of Raphoe, where there is a neat, though not large cathedral, and an old but convenient palace. It is near the one extremity of the diocese, and about 50 English miles from the other. The patronage of six parishes is in the crown; of fifteen in the bishop; of seven in the University of Dublin; and of three in lay lands. Each parish, on an average, contains about 16,179 acres, and 3,950 souls. The greatest proportion by far of Protestants in this county are Presbyterians. The Anti-burgler Seeders have four congregations here, viz., at Taughboney, Cavanoe, Ray, and Rathmelton. The Roman Catholics are numerous, and comprehend the greatest part of the population. The Catholic bishop of Raphoe has about L.1,000 per annum. He is paid by a poundage on the income of his clergy. At Donegal (town) the priests are paid by a bank of yarn; and for confession, they receive a peck of oats, or 2s. 2d. in money, from the head of each family. There are few Catholic chapels; so that the priest and his congregation meet sometimes under the shelter of a rock, or any other that they can conveniently find. The only Catholic of great landed property is Lord Southwell, who has a good estate; and as there is so little property of this kind in the hands of the Catholics, none of them are ever on a grand jury. The militia regiment has not a single Catholic officer. There is a free and friendly intercourse between the Catholic clergy, and the few country gentlemen who reside. Great and disgraceful riots, however, have been from time to time excited by mobs of Orangemen, which have given occasion to trials.

The county of Donegal is about 72 English miles long, and 51 broad; and contains 1704 English square miles, or 1,091,736 acres. According to Dr. Beaufort's estimate, in 1792, there are 23,521 houses, 140,000 inhabitants, 46,556 acres to a house, and about 13.8 souls to a square mile, and nearly six to a house. By the return made to Mr. Bushe, (see Memoirs of the Royal Irish Academy for 1789,) the population of Donegal is stated to be at the rate of 7.35 to a house. The number of houses in 1791, as returned by the inspector-general of hearth-money, was 24,976, of which 15,395 had one hearth, 1,225 had one, 282 had three, 97 had four, 55 had five, 24 had six, 14 had seven, 20 had eight, 5 had nine, 6 had ten, 20 had more than ten and less than forty-four, besides 648 which were exempted as new, and 715 as paupers. The population of Donegal is inferior to that of twenty-nine counties of the thirty-two, which Ireland contains. The proportion of Catholics to Protestants is as six to one; there being 116,667 Catholics, and 23,333 Protestants. See Beaufort's Memoir of a Map of Ireland; Newenham's View of the Natural, Political, and Commercial circumstances of Ireland; M'Parlan's Survey of Donegal; and Wakefield's Statistical and Political Account of Ireland. (+)


DOROENA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 136.

DORCHESTER, is in the hundred of Uggescombe, in Dorsetshire, of which it is the county town. Its distance from London is very nearly 120 miles south-west. It sends two members to parliament, a privilege which was conferred on it by 25 Edward I. The right of election is vested in the inhabitants, paying to church and poor, in respect to their personal estates, and also in such as pay to the church and poor, in respect to their real estates within the borough. The number of the voters is about 400. The government of the town is vested in a mayor, 2 bailiffs, 6 burgesses, 6 capital burgesses, a governor, and 24 common council men. The form of the town is an irregular square, though there is reason to believe, that anciently it made a complete one. It consists principally of three spacious streets, which unite nearly about the middle. They are well paved and lighted, and kept remarkably clean; but in this, as
DORCHESTER, Dorset.  

well as most of the other towns in this county, there is a great dulness and want of activity. There are several well constructed and rather elegant buildings of brick and stone; the most remarkable of which are the three churches, St Peter's, Trinity, and All Saints. The town-hall is very spacious and convenient, under which is the market-place; and behind it two rows of butchers' shops. The county hall is remarkable rather for its neatness and commodiousness, than for the taste or elegance of its architecture; and the gaol, which, under the same roof, contains a county gaol, a penitentiary house, and a house of correction. It is built exactly and entirely on the plan so strongly recommended by the late Mr Howard. In its external appearance, as well as in its situation, this building is very striking; and its interior is arranged and fitted up in the manner best suited for its destination. The buildings consist of a lodge, keeper's house, chapel, debtors' day rooms, female fires, and female debtors rooms, visiting rooms for male debtors, felons' infirmaries, &c. Besides the main building, there are four wings, which, though detached, communicate with the centre in each story by means of cast iron bridges. The sleeping cells will accommodate 88 prisoners, and they are distributed in the different buildings. The condemned prisoners are confined in four cells, light and airy; and such as are violent and refractory, are confined to four that are perfectly dark. The male prisoners are completely separated from the female; and the prisoners of each sex are divided into classes, for each of which separate subdivisions are appropriated, by means of distinct stair cases, with courts, work rooms, &c.

Dorchester was formerly famous for its woollen manufacture; but this is now gone to decay. At present it is chiefly celebrated for its ale. The situation, as well as the environs of the town, are very pleasant. It stands on an ascent above the river Frome, (which bounds it on the north side,) about six miles from the English Channel. On the south and west the downs open to the view, rich in pasture, or, where tilled, affording abundant crops of corn. Dry and pleasant walks, planted with rows of lime and sycamore trees, accommodate the inhabitants, and adorn the vicinity of the town on the south and west, and partly also on the north and east. Dorchester was a place of considerable importance in the time of the Romans, as the Via Icniana; on which it stands, and the several vicinal roads which branch from this, as well as the coins, &c. found here, abundantly testify. In 1595, it was visited by a most dreadful plague. In 1613, 300 houses were destroyed by fire, and the loss was estimated at L.200,000. There are three fairs held in it for cattle, sheep and lambs, wool and leather. The market days are Wednesday and Saturday. Its population in 1811 was 2546. (w.s.)

DORDOGNE, the name of one of the departments of France, derives its name from the river Dordogne, which traverses its southern part from east to west. It is bounded on the north by the departments of Upper Vienne and Charente, on the west by those of Lower Charente and Gironde, on the south by that of Lot and Garonne, and on the east by those of Lot and Correze.

The principal rivers of this department are the Dordogne, the Ille, which passes Perigueux, the Hute, the Upper Vezere, &c. Of these, the Dordogne and the Ille only are navigable. The Dordogne is navigable before it reaches Libourne, and the Ille is navigable from Contras to the Dordogne. The country is mountainous and well wooded, and the air is pure, though cold. There are several extensive plains, and very fine valleys, in the department. The soil is generally stony, and more than one-third of it is in cultivation. Corn is raised only on the banks of the Ille and the Dordogne, and, in consequence of the want of meat, chestnuts form the chief article of food for the inhabitants. In some of the cantons there are good meadows, which might be turned to great account in the fattening of cattle. Game, (which is principally red partridges,) fattened poultry, and truffles, which accompany always the turkeys and poultry in Perigueux, if they do not form the riches, are at least the resources of this department. The productions of the soil are corn, maize, wines, of which those of Bergerac and Domme are the most celebrated; truffles, chestnuts, and walnuts. The principal articles of commerce are poultry, pigs, cattle, chestnuts, brandy, timber, iron, knitted hosiery, paper, and earthen ware. The iron mines produce excellent iron, which is used in the common founderies, and supply 63 forges, the most important of which are those of Somerelles, Ans, Eysies, Montenas, and de Lavaur; and there are also several mineral springs in the department.

This department has a superficial extent of 9182 square kilometres, or 480 square leagues. The forests, which are very extensive, though in a state of decay, occupy 60,000 or 70,000 hectares, or about 135,000 or 136,000 acres; of which 64,000 hectares belong to individual proprietors. The average contribution of every individual to the expences of the state is nearly 6s. 6d. sterling; and in the year 1808, the contributions to government amounted to 3,171,612 francs. The following is a list of the principal towns, with their population.

<table>
<thead>
<tr>
<th>Town</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perigueux</td>
<td>3733</td>
</tr>
<tr>
<td>Bergerac</td>
<td>8510</td>
</tr>
<tr>
<td>Sarlat</td>
<td>5924</td>
</tr>
<tr>
<td>Ribesac</td>
<td>2985</td>
</tr>
<tr>
<td>Nontron</td>
<td>2609</td>
</tr>
<tr>
<td>Montpazier</td>
<td>1000</td>
</tr>
<tr>
<td>Belves</td>
<td>1700</td>
</tr>
</tbody>
</table>

Perigueux is the capital. The total population of the department is 410,350. It is stated at 426,000 in the Almanach du Commerce pour 1811. See Herbin's Statistique de la France; and Chantreaux's Science de L'histoire, &c. (s.)

DORDRECHT, or Dort, Dordrecht, or Dortrecht, is an ancient town of Holland, and is one of the richest and strongest in the kingdom. It is situated at the embouchure of the Meuse, which here takes the name of Merwe. The harbour is commodious, and has from 20 to 24 feet of water at spring tides. Vessels which draw 10 or 12 feet of water can enter it at all times. By means of the river Waal, which passes before the town, great floats of timber are brought to Dordrecht, which can enter the harbour at all tides. These floats are sometimes so enormous, that 500 men are sometimes necessary to conduct them. The timber is cut in the sawing-mills, which are numerous in the vicinity of Dordrecht.

Dordrecht is the magazine for the Rhenish wines, which are brought down the Rhine and the Meuse, for all sorts of iron-work, lime, marble, coal of Liege and Namur, and other articles of merchandise, which are conveyed in boats from Cologne and Gueldres. There are refineries of salt, and bleaching establishments at Dordrecht; and there is a considerable fishery.
particulars of salmon. The position of Dordrecht, according to trigonometrical observations, is in East Long. 4° 59' 42", and North Lat. 51° 48' 54". (j)

DORIA, ANDREW, one of the most celebrated naval commanders in the 16th century, was born at Genoa A.D. 1466. Descended from one of the noblest families in that city, he soon rose to the highest offices in the service of his country; and commanded the Genoese fleet for several years before the republic fell under the power of Francis I. in 1522. From this period he directed the naval operations of the French monarch with great success; and particularly gained a complete victory over the Spanish fleet under Moncada, on the coast of Naples, in the year 1528. In this situation, however, his independent spirit, as the citizen of a republic, and his unceremonious manners as a seaman, gave frequent umbrage to the French courtiers, who employed every artifice to render him obnoxious to their king. When the French began to fortify Savona, with an evident intention to render it the commercial rival of Genoa, the patriotic Doria demonstrated in the highest tone against the measure, and even made an offer of 300,000 crowns, in order to secure the privileges of his native city. His conduct having been represented as unpatriotic in the most aggravated point of view by the French monarch, was treated to such a degree, that he commanded his Admiral Barbiesiaux to sail directly to Genoa, to apprehend Doria, and to take possession of his galleys. Doria, having received timely intelligence of this order, retired with his fleet to a place of safety; and in the height of his indignation, having sent back his commission with the order of St Michael to Francis, he entered the service of the Emperor Charles V. To deliver his country from a foreign yoke was his principal inducement in taking this step, and the object of his highest ambition. Having learned that the French garrison which held the Genoese in subjection, was much reduced by the pestilence, and that his countrymen were ready to second his measures, he landed a small body of men during the night, who surprised one of the principal gates, and gained possession of the city without opposition or bloodshed. Aided by the fame of his exploits, the support of the emperor, and the gratitude of his countrymen, he might, without much difficulty, have rendered himself the sovereign of Genoa; but, sacrificing all views of his own aggrandizement, and claiming no pre-eminence or power above his equals, he remitted the settlement of the state to an assembly of the citizens; and the ancient form of the republic was re-established with universal approbation. In the following year, the Emperor, having landed at Genoa on his way to Italy, honoured him with many marks of distinction, and always had recourse to his abilities in every naval operation of any importance. Having been ordered, about this time, to chastise the insolence of Barbarossa, whose corsairs had committed depredations upon the imperial flag, he attacked a part of the piratical fleet in the port of Sorgee, drove the crews ashore, and brought out nine of their galleys. In 1592, he gained repeated successes over the Turkish fleet, and reduced their principal forts in the Morea. In 1595, he acted as high admiral of the fleet in the famous expedition to Africa, which was conducted by the emperor in person, and which so successfully broke the power of the pirate Barbarossa. In 1541, he again conveyed the emperor to the African coast, after having in vain represented to him the dangers of such a voyage at the season when it was attempted, and having faithfully predicted, as was so fatally verified, the unavoidable destruction of the whole armament. But amidst all his expeditions, he watched incessantly, like a tutelary divinity, over the welfare of Genoa, and even when removed to a distance, was often, by his vigilance and foresight, the means of preserving the liberty which he had established. Beloved and respected by his countrymen, he continued to possess a powerful influence over the councils of the republic; and, while he adhered to his purpose of living as a private citizen, yet from the veneration which he acquired by his virtues, he felt himself in a manner invested with all the authority of a sovereign. While all admired his talents, and respected his disinterested conduct, there were a few who viewed with jealousy his ascendancy in the commonwealth. They had indeed ample security in his age, his moderation, and his love of liberty, that he would never abuse his power, or injure that free constitution, which it had been the chief glory of his life to establish; but they had begun to recognize a formidable enemy to their liberties in his grand-nephew Giancamino, whom he had adopted as the heir of his private fortune, whose gratification and aggrandizement he indulged without bounds, and who gave daily proofs, by his haughty and overbearing manners, that he aimed also at succeeding his uncle in authority and power. Of these apprehensions and murmuring ones, John Lewis Fiesco, Count of Lavagna, took advantage in his ambitious schemes, and formed one of the most daring conspiracies recorded in history against the life of Doria, and the liberty of his country. One of the most illustrious subjects of the republic, and possessed of qualifications to attract the respect and affection of his fellow-citizens, he found means to collect a number of bold adherents, to whom he intrusted his plot, and to secure a multitude of friends, who, though ignorant of his designs, would be ready to support him in power. His object was to assassinate the two Dorias, with the principal persons of their party, and abolish the republican form of government, to proclaim himself Duke of Genoa. By appearing entirely devoted to a life of dissipation, and by paying the most respectful attentions to Doria and his nephew, he completely disguised his design, till they were fully ripe for execution. On the night between the second and third day of January 1547, during the interval between the demission of the doge of the former year and the election of his successor, the conspirators rushed forth to get possession of the gates, to seize the galleys in the harbour, and to attack the palace of Doria. Giancamino, awakened by the noise of the tumults, and imagining it to be occasioned by some mutiny among the sailors, hurried with a few attendants towards the harbour; but, falling in with a party of the insurgents in his way, he was beheaded and murdered on the spot. His uncle, in the mean time, having received intelligence of this event, and of the danger which threatened his own person, instantly mounted on horseback, and saved himself by flight. But Fiesco, in the midst of his success, while passing hastily by means of a plank from the shore to one of the galleys, fell into the sea, and sinking to the bottom by the weight of his armour, perished in the moment of triumph. In his death, the cause of the conspirators received its mortal blow; and the whole body, having lost the spirit by which it was animated, was almost instantaneously dismembered and dispersed. On the following morning the city of Genoa was freed from every vestige of an enemy, and Doria, returning to his residence in the evening, was received by the inhabitants with acclamations of joy. He conducted himself with
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Dorset, Dorsetshire.

the utmost moderation and magnanimity; and the de-

DOR KING, a market town of England, in the coun-

ty of Surrey, and hundred of Dorking, is situated near the river Mole in a sandy vale, sheltered on the north by the ridge of chalky down which runs across the county. The town consists of three streets, the east, the west, and the south, which are tolerably clean, and are well watered with springs. Most of the houses are built on the side of a hill, which consists of a soft sandstone, excavated in many places into cellars. The church, dedicated to St Martin, is 127 feet long, and consists of a nave with north and south aisles, a chancel, and a low embattled tower, containing eight bells with a clock and chimes. The breadth of the nave and aisles is 53 feet, and that of the chancel 191. The body of the church is built of the stone and flints of the county, and the upper part of the tower of squared stone or chalk. The Roman road from Arundel to Dorking, is said to have been often discovered by those who were employed in digging the graves. There is at Dorking a workhouse, and some almshouses, on a pleasant little heath called Colman Dean. The town-hall stands in the middle of the High-street. There are several corn-mills in the neighbourhood of Dorking, and linen is manufactured to a considerable extent. There is a well-supplied weekly market every Thurs-

day, and an annual fair on the eve and day of the Feast of the Ascension. This town has been long celebrated for a kind of fowls with five claws, called Dorking fowls, which are bred and fattened in great quantities, and sent to the London market. One kind is perfectly white, and another of a partridge colour. Numerous mansions and villas are erected in the immediate neighbour-

DOR, of Surrey, continued by William Bray, Esq. and She-


DORONICUM. See Sutherland.

DORONICUM, a genus of plants of the class Syn-
genia, and order Polygama Superfam. See Botany,
p. 300.

DORSETSHIRE is a maritime county, lying in the south of England, between 50° 30' and 51° 6' north latitude, and 1° 58' and 3° 18' west longitude. Its form is irregular on all sides. On its long northern side, it has a great angular projection in the middle; and its sea coast runs out into points and headlands. If measured across the centre of it from north to south, it stretches about 56 miles; and from east to west it is rather more than 50 miles. Towards the south-west corner, a small portion of it is cut off and surrounded by Devonshire; and, on the other hand, a small part of Somersetshire is inclosed in Dorsetshire. This county is bounded on the north and north-east by Wiltshire; on the south and south-west by Somersetshire, from which, for a little way, it is divided by the river Yeo; on the east by Hampshire; on the west by Devonshire; and on the south by the British Channel. The northern parts, especially on the borders of Wiltshire, are in general level; and on the north-east corner a considerable forest formerly existed, which still retains the name of Cranbow Chase. A ridge of lofty chalk hills runs across the middle, nearly to where the county joins Devonshire. The part bordering on Somersetshire is beautifully varied in surface, and presents many extensive and rich valleys. That part of Dorsetshire which lies next Hampshire, is a dreary barren heath, which likewise stretches along the coast for a considerable way.

In point of size, Dorsetshire, when compared with the other counties of England, may be deemed rather large. It is said from the best authority, to contain of arable land 153,588 acres; pasture land 169,031; mea-
dow 78,628; commons 26,916; downs 31,272; heath land 29,979; woods 12,755; copses 2779; plantations 2020; waste 1586; to which must be added for rivers, water courses, roads, land occupied by towns, farm buildings, &c. 8000 acres: making on the whole 512,154 acres. It is divided into divisions, hundreds, boroughs, liberties, and tithings. There are 9 divisions: Blandford North, or Blandford; Blandford South, or Wareham; Bridport, or Beaminster; Cerne; Dorchester; Shafton East, or Wimborne; Shafton West, or Shaftesbury; Sturminster; and Sherborne. The division of Blandford North comprises three hundreds, one borough, (Blandford Forum,) one liberty, and 82 tithings. The land rate at 4s. in the pound, amounts to L2,138, 6s. 6d. and when a single county rate is raised, the sum paid out of the poor's rate amounts to L32, 17s. 8d. The division of Wareham contains five hundreds, two boroughs, (Corfe Castle, and Wareham,) three liberties, and 65 tithings. The land rate amounts to L3,308, 13s. 7d. and the sum paid out of the poor's rate to L43, 16s. 6d. The division of Bridport contains five hundreds, two boroughs, (Bridport, and Lyme Regis,) four Bridport liberties, and 68 tithings. The land rate amounts to L6,117, 3s. 11d. and the sum paid out of the poor's rate to L59, 16s. 1d. In the division of Cerne, or the subdivision, as it is sometimes called, there are three hundreds, three liberties, and 34 tithings. It contains no borough town. The land rate amounts to L2,562, 1s. 10d. and the sum paid out of the poor's rate to L42, 14s. The division of Dorchester comprises five hun-
dreds, two boroughs (Dorchester, and Weymouth and

See Manning's History and Antiquities of the County

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Melcombe Regia, six liberties, and 81 tithings. The land rate amounts to L. 5980, 8s. 5d. and the sum paid out of the poor's rate to L. 95, 1s. 3d. In the division of East Shaston, there are no liberties and no boroughs; the number of tithings is 62. The land rate amounts to L. 4458, 9s. 4d. and the sum paid out of the poor's rate to L. 66, 13s. 4d. In the division of West Shaston there is not a single hundred, there is only one borough, (Shaftsbury,) and there are only two liberties, and 27 tithings. The land rate amounts to L. 3287, 17s. 4d. and the sum paid out of the poor's rate to L. 31, 3s. 6d. In Sturminster division, there are three hundreds, no borough town, one liberty, and 27 tithings. The land rate amounts to L. 3013, 18s. 10d. and the sum paid out of the poor's rate to L. 44, 2s. 6d. In the division of Sherborne, there are two hundreds, no borough town, two liberties, and 38 tithings. The land rate amounts to L. 1760, 16s. 5d. and the sum paid out of the poor's rate to L. 42, 3s. 6d. From this statistical account, therefore, it appears that Dorsetshire comprises 34 hundreds, 8 borough towns, 22 liberties, and 430 tithings; and that the land rate at 4s. in the pound, amounts to L. 92751, 18s. 6d.; and the sum paid out of the poor's rate, when a single county rate is raised, is L. 500. This county is comprised within the diocese of Bristol. It is divided into five deaneries: Bridport, in which are 48 parishes; Dorchester, in which are 45; Whitechurch, in which are 55; Pimperne, in which are 52; and Shaston, which contains 56; so that in the whole county there are 236 parishes. Dorsetshire lies in the western circuit. The assizes were formerly held at Sherborne, but now they are held at Dorchester.

Climate.

This county is usually represented as the garden of England, though it would be difficult to make good its claim to this character, either in respect to climate or soil. The climate undoubtedly is, on the whole, salubrious, and this it appears to have been accounted in very early times; for it is remarked, that the Romans had more summer stations in this county than in most other parts of England; and the Saxon monarchs built in it a great number of palaces and minsters. But the climate, though undoubtedly salubrious, is not bland and mild as in some other of the western counties; and it has been supposed, that the very circumstance of clearing off the wood, which renders most tracts of land more healthy and warm, in Dorsetshire has rather produced the opposite effect; since as a large portion of the county is exposed, the cutting down the timber would render the air keener and colder, while from the nature of a great part of the soil,(chalk,) there was no occasion for the usual benefit attending this operation, viz., rendering the climate drier. The air on the hills is keen; on the sea coast, more rain falls in winter, and less in summer, than in most other parts of England; and the sea fogs hang on the hills sometimes for a week together. The prevalent winds are the west and southwest, which may be distinctly traced by their effects on the younger trees, which generally bend to the east and north-east. The harvest is not early, seldom commencing, even in the more sheltered spots, and on the richer soils, before the middle of August. The county in respect to soil, is naturally divided into three districts; viz. chalky loam, gravelly sand, and clay of various strength and goodness. The chalk commences as we enter the county from Wiltshire, and runs through the centre of it by Dorchester, nearly to Bridport. In some places, the soil above the chalk is deep and rich, in others thin and poor. The appearance of this district is, in general, smooth and verdant; but there is almost a total want of hedges, timber, and young plantations. The sandy district is the termination of that which extends to Bagshot heath; and though in this county parts of it are by no means unproductive, yet on the whole it is a barren tract. Clays are principally found on the borders of Somersetshire and Devonshire; and in the isle of Purbeck, about Sherborne and Stalbridge, the soil is a rich loam on a chalky rubble. Immediately round Shaftsbury, deep rich sandy loams prevail, of a very light nature, and remarkable for the earliness of their produce. Perhaps the most fertile soils are round Bridport. They consist of a very deep dry loamy sand, admirably calculated for all kind of crops. Some of the valleys in the north-east part of the county are also uncommonly rich, particularly the vale of Blackmoor, (extending from north to south about 19 miles, from east to west about 14, and containing upwards of 150,000 acres,) through which the Frome runs. It consists of a deep rich clay. The soil on the sea coast is either heath, or a thin poor clay, till we reach Abbotsbury, when it improves into a deep loam.

The coast of Devonshire, as it approaches that of Dorsetshire, gradually turns from the south-east towards the south, till it reaches Lyme, when it begins to front the south-west. By this means an immense gulf is formed, which includes the greater part of the south of Devonshire, and north of Dorsetshire; and within this gulf there are several smaller bays principally belonging to this county. These bays are commanded by the isle of Portland, immediately below which the fine bay of Weymouth opens. This is formed on one side by this island, and on the other side by Purbeck, which stretches out to the south-east. When we trace the coast of Dorset beyond Purbeck, the bay of Studland presents itself, fronting the east; and afterwards the great expanse of Poole harbour. In this harbour, a singular appearance is noticed. The singular sea ebbs and flows four times in the 24 hours, twice on the moon is at south-east and north-west, and twice when she is at south by east and north by west. This is supposed to be occasioned by the isle of Brownsea, which lies near the entrance of Poole harbour, obstructing the water. The rivers in this county are neither large nor numerous. The Frome rises in Somersetshire, and flowing south by Weymouth, falls into Poole bay, three miles below the former place. The Stour takes its rise in Wiltshire, and flowing south to Sturminster, afterwards pursues a south-east direction, and meeting with the Avon of Hampshire, it falls into the sea at Christchurch. The other rivers are the Yeo, the Piddle, the Char, and the We.
DORSETSHIRE.

agriculture of Dorsetshire presents few subjects that are very interesting. It is by no means well farmed, except in what respects the management of their sheep, the dairy system, irrigation, and the culture of hemp.

The principal sheep country is round Dorchester, within eight miles of which it is calculated that nearly 200,000 sheep are kept, of which about a fourth part are sold every year principally at Weyhill fair. The whole county supports upwards of 600,000 sheep, of which nearly 200,000 are annually sent out of it. Dorset has long been famous for its breed of sheep. As they lamb in very early season, they are brought up to supply the metropolis with house lamb. They are large sized, with round and bold horns, deep carcase, and short legs. There is no mixture of colour in them if they are pure Dorsets. The Wiltshire sheep resemble them most. They thrive remarkably well on the rich pasture of the downs. Besides this breed, there is a small kind in Portland and Purbeck, the flesh of which is uncommonly sweet. It seldom weighs more than 10 lb. a quarter.

The dairy system of Dorsetshire is peculiar to it, and some other of the south-western counties: the plan is for the farmer to find the dairy-man, as he is called, a certain number of cows, at a fixed sum, which he supports throughout the year. The usual price paid for the use of each cow is from L. 10 to L. 14 annually. Little cheese is made here; but the London market is supplied with large quantities of salted butter, which is reckoned inferior only to the Cambridge butter. The admirable improvement of irrigation is well understood, and very generally practised in this county; indeed it may be said to have been revived by a native of it, Mr Boswell of Fiddletown, whose treatise on the subject is complete and satisfactory in all that relates to it. The watering commences at or before Christmas, and is occasionally repeated, so that in general, by the middle of March, there is sufficient water for cows and lambs; these are grassed till the month of May, when they are taken out, and the meadows again watered; by this plan about the beginning of July nearly two tons of hay per acre are obtained. As soon as the hay crop is off, they are again watered till September, when the dairy cows are put on them till near Christmas. The different cuts for this purpose are made with great judgment; the expense at first is from L. 4 to L. 6 per acre; afterwards there is very little trouble or expense attending them; watermen, as they are called, attending the meadows, to put all the cuts, &c. in order through the winter, for 3 shillings per acre. Hemp and flax are principally cultivated on the deep rich loams near Bridport. From 1782 to 1792, 86,571 stone of the former was grown, the bounty on which amounted to L. 1082. 2. 9. Since the year 1792, the bounty has been discontinued, so that the exact quantity now grown cannot be ascertained; but it is supposed to be very considerably increased. It is calculated that 500 acres are under this plant. Between 1782 and 1792, 301,726 stones of flax were grown; on this the bounty amounted to L. 5028. 15. 4.; at that time 1700 acres were supposed to be under flax; at present it is calculated there are at least four times as many. The only circumstance attending the preparation of flax, either peculiar to this county, or at least not common, is the mode of ripening it. It is not watered in pits or brooks, as in most other parts of England, but exposed for three or four weeks to the action of the dews and rains on the stubble, or meadow-land; hence it is called dem ripened flax. The price of wheat in Dorsetshire, on an average, for a very great number of years, is found to be above the average price of wheat in England and Wales, as inserted in the Gazette, while the price of barley was below the average of the kingdom.

Dorsetshire is rather an uninteresting county to the botanist; on the beach of Weymouth, however, most of the flax that can be found in the south of England are thrown up by the sea: the isle of Portland affords Euphorbia Portlandica in great abundance; and, on the higher parts of the island, Lavatera arborea, tree mallow, is found. Linen is extensive, eschallot, has also been met with here. On the Chesil banks there are several marine plants, particularly Salsola fruticosus, Insula crithmifolia, and Pium maritimum. On the heath between Morden and Wareham, Exacum filifforme (Marsh centaury) grows; this rare little plant, Dr Maton remarks, has never, as far as he knows, been found farther northward; it grows on spots overflowed in the winter. Near the harbour of Poole, Santolina maritima, another rare plant, is met with. On the veins of chert, which form Lulereak cove, Lichen concentricus appears; and on the shore, near the same spot, a singular variety of Fucus nodosus. On the declivity of some chalk hills at Loders, in the vicinity of Bridport, Opurys spiralis (spiral tway-blade) grows in considerable abundance. Dr Pulteney discovered on Hodhill, in Cranborne Chain, Cineraria integrifolia, (mountain flea-wort,) and Dr Maton observed Thesium linophyllum, (bastard toad-flax,) and Ruthia sylvestris, in a wood skirting the declivities of the hill.

Dorsetshire is rather more interesting to the geologist and mineralogist. The western border of the county is nearly the limit of that singular but by no means uncommon phenomenon, which has puzzled all geologists—the occurrence of flints in the chalk. Within four miles of Honiton, in Devonshire, it totally disappears. The extent of this formation, therefore, according to Dr Berger, setting out from London, and going in a direct line from east to west, is about 150 miles; but though this formation still exists far inland, yet it ceases long before in the cliffs which form the sea coast. Flints in the chalk are very conspicuous in the cliffs of the Isle of Wight; but the island of Portland presents a grit, with a calcareous cement; and Lyme Regis a shell limestone. This contains, some very beautiful and large specimens of ammonites, &c. In the Isle of Purbeck, the chalk hills lie in the prolongation of a line westward from the Needles. The hill; on which Corfe Castle stands, consists of what is termed hard chalk. Coarse shelly limestone, which is thought to be very rare in England, is met with in Purbeck and Portland; in some places, it includes patches of a compact limestone, which becomes harder, as it passes gradually into a state of complete flint or chert. In the quarry of Tillywhim, in the isle of Purbeck, the stone is principally composed of shells of oysters that have lost their outside coat. The marine remains, found in the Portland stone, are principally species of Trigonia of Lamarck, a genus of which a living species has been found in the South Sea. The specific gravity of the coarse shelly limestone, Dr Berger found to be, from Swanage quarry, 2.505. Portland north-east quarry, 2.565. Tillywhim quarry, just where it passed into a calcareous sandstone, 2.465. The specific gravity of the composite limestone, from the Tillywhim quarry, was 2.511; and from Portland, 2.511. The specific gravity of chert from Portland was 2.545. Oviform limestone is met with in the quarry of Wardship, in the
The isle of Purbeck has also several valuable stone quarries, the principal of which are in the neighbourhood of Swanage. The stone differs from that of Portland, and is not so valuable or useful. It is principally composed of shells and other marine remains, cemented very closely by calcareous spar. That which is got at Swanage takes a fine polish, and looks like alabaster; formerly a kind of black stone, called Purbeck marble, was obtained. Some fine specimens of it are to be seen in the church at Christ-Church. The pillars of Salisbury cathedral are also made of one species of Purbeck marble. The hills, out of which the stones are dug, run nearly east and west. Near the shore, they are 400 or 500 feet high, and higher inland. The dip is very considerable to the north, the uppermost bed of stone lying near the surface, while, in about 300 yards, it sinks below the sea. The average export of this stone is about 40,000 tons. It is mostly used for flag-stones for paving; and the greatest part is shipped from Swanage for London. The price is about 40s. per hundred feet superficial. The thickness is generally from 2½ to 3 inches; and reckoning that 14 cubic feet are a ton weight, a hundred superficial feet will weigh about 1½ tons. The men employed in digging the stones are about 300. The ground rent paid to the owners of the land is about 6d. per ton for all kind of stones raised here.

Potters' clay is found in great abundance, and of excellent quality, in the northern division of the isle of Purbeck; and it probably forms the substratum of the whole tract, which may be called the Trough of Poole. The existence of alumine, lime, magnesia, oxide of iron, and silica, has been detected in some specimens of it; but, in general, it is very free from these substances. It feels greasy and smooth, and varies in colour from ash grey to blue. It contains sometimes cylindrical blue nodules, (to which the workmen give the appellation of pins,) the texture of which is close, and the composition probably more ferruginous. The specific gravity of the purest specimens is about 1.723. The principal pits are to the west of the road between Wareham and Corfe Castle, where the stratum extends about three miles in length, and one in breadth: the depth, as well as the quality, varies very much. Farther to the east is a kind of clay of a brown colour, which shrinks very much in the fire. It is reckoned that about 20,000 tons are annually exported, principally for the use of the potteries in Staffordshire. The inferior kinds are sent to London and Bristol, to make brown stoneware. The goodness of the quality depends chiefly on the small proportion of iron which it contains; where there is much of it, the clay will not burn white, and the particles of iron cause it to blister. Upwards of 100 men are employed in the clay pits; many more were employed before an iron rail-way was constructed, from near Corfe Castle to a small harbour opposite Poole; to which it is carried in boats, and shipped thence for Liverpool, London, &c. As the digging of the clay requires great care and attention, it is seldom done by piece-work, but commonly by the day. Three shillings and sixpence is the usual wages. It is delivered in Poole harbour at 20s. a ton, and 2½ cwt. extra is allowed, on account of the loss of weight which it experiences. A species of chalk, found near Rampisham, deserves notice: it seems a kind of Tarras, as it has the quality of growing (as it is termed) under water, i.e. it swells, and at the same time becomes harder.

Dorsetshire is not a manufacturing county. In the
DORSETSHIRE.

Manufactures.

neighbourhood of Bridport and Beaminster, the hemp which is grown there is made into twine, netting, ropes, cordage, sail-cloth, sacking, &c. About 9000 people are said to be employed in these manufactures. At Sturminister Newton, 700 or 800 people are engaged in the manufacturing of swansdown; and at Sherborne, Stallbridge, and Cerne Abbas, there are several silk mills. But the manufacture (if so it can be called) most frequently met with in Dorsetshire, is that of shirt buttons. Shaftsbury and Blandford may perhaps be considered as the centre of this business, though it spreads nearly over the whole county, and is the principal employment of the women and children. The casting, or covering the wire, is done by children, six or eight years old; they are afterwards filled, as it is termed, by more expert hands. It sometimes happens that an active and experienced woman will make twelve dozen of these buttons in a day; the price is about 3s.; but the common quantity made in a day is six or seven dozen.

The principal foreign trade of this county is carried on from Poole, where nearly 200 sail are employed in the Newfoundland fishery. The foreign trade, however, was much more extensive and valuable before the American war. From this port are exported to Newfoundland, provisions, nets, cordage, oil-cloth, and wearing apparel. The imports are principally cod and salmon, dried and salted, which are afterwards shipped to foreign markets; oil, seal-skins, fir, and cranberries. The exports of Portland and Purbeck have been already noticed. From Bridport there is a trifling export trade to Newfoundland, and other parts of America and the West Indies, of cordage, twines, &c. Coal and culm, for burning limestone, are imported into the county to a considerable extent. There is but one iron rail-way, which has been already noticed, for carrying the clay from Purbeck. The declivity of the road is in some places four inches, and in others five, for every twenty yards. The expense of making it was about £2000 a mile. The whole length is 33 miles. Three horses draw 10 tons to the sea side, three times a day, at the expense of about 6d. a ton. There is also only one canal, the Dorset and Somerset, which commences at Gains Cross, in the parish of Shillingstone Okeford, in the former county; and after passing through part of Somersetshire and Wiltshire, communicates with the Kennet and Avon Canal, near Wiltsbrooke, in the latter county.

Dorsetshire is distinguished for its sea prospects; many of which are uncommonly extensive, and partake of all that magnificence with which the sight of the ocean impresses every beholder. Its land prospects, except in the north, and north western parts of the county, are rather bare and unvaried; but where the rich valleys can be taken in, along with the chalky hills and downs, they are very beautiful and impressive. One of the finest inland prospects is seen from the hill on which Shaftsbury stands: "in front, an eminence, called Pendle Hill, rises with a beautiful wooded summit, bounding the fertile vale of Blackmoor, through which a white road, sometimes losing itself among woodlands, and sometimes traversing verdant pastures, winds westward into the distance. On the left, a fine undulating ridge shelters the vale; while the hills of Mere, in Wiltshire, with Alfred's Tower at the extremity; the Tor of Glastonbury, and the lofty heights of Quantick, in Somersetshire, range themselves in the remaining part of the horizon."

The most interesting natural curiosities in this county are the Chesil Bank; the Agglestone; and the Lynches, or Lynchetts. The Chesil Bank unites Port-

land to the Main; it is nearly 17 miles in length; and in some places nearly a quarter of a mile broad, so that it is perhaps the longest ridge of pebbles in Europe, except that of Memel. The pebbles are extremely loose; they consist, in general, of what are called Portland pebbles, of a calcareous nature; but there are many of jasper, chert, quartz, &c. They diminish gradually in size as they approach the main land, being not larger than horse beans near Abbotsbury, while, near Portland, they are from one inch to three inches in diameter. About five or six feet beneath the surface of the pebbles, there is everywhere strong clay, exactly similar to what is found on the beach. Beneath this bank, and the Weymouth side, a narrow arm of the sea runs, called the Fleet. Although the force of the sea frequently washes these pebbles over into the Fleet, yet the depth or breadth of this does not appear to be diminished; indeed the origin and present appearance of this bank is extremely difficult to be accounted for. The Agglestone is an extraordinary insolated rock, situated on the heath, near Studland, in Purbeck; its height is about 20 feet, and its circumference about 80; the shape nearly that of an inverted cone. From the circumstance of the spot where it stands being raised like a barrow, it has been supposed to be a British monument; but Dr Maton, with more probability, conceives it to be a natural rock, composed of ferruginous sandstone. The Lynches, or Lynchetts, are met with in many places, on the downs, both of this county and Wiltshire; they are singular natural terraces, never occurring except on chalk hills, and on some limestone soils, where, however, their appearance is very faint. Between Shaftsbury and Blandford, they are very conspicuous. They are always narrower in proportion to the steepness of the ascent; where the declivity is trifling, the areas are very broad, and the ridges diminish in sharpness; they generally run parallel to the course of the valley below; and where the valley presents great inequalities, or the hill on which they are irregular, they cross one another, and run in all directions. Dr Maton supposes that they owe their origin to subsidences of the ground in a state of solution.

Of the Antiquities of Dorsetshire, the Fia Iceniana: Antiquities. Maiden Castle, near Dorchester, one of the finest Roman encampments in the west of England, for size and strength; a Roman amphitheatre, near the same tower, which it is computed could have contained upwards of 12,000 people; and Corfe Castle, and Wimborne Minster, in which the transition of the Saxon into the Gothic arches may be distinctly traced, are the most curious and interesting.

At the time of the invasion of Britain by the Romans, History. Dorsetshire was inhabited by the Deceangli, a name supposed to be derived from two British words, dweyr, water, and irig, an inhabitant; it formed part of the Roman division of Britannia Prima. The Saxons changed its name to Dorseta, retaining the British word dweyr, and adding the Saxan term setta, a dweller. It constituted part of the West Saxon kingdom; and after the dissolution of the Heptarchy, became the favourite residence of Egbert and his successors. The Danes invaded it early in the reign of this monarch, and an obstinate battle was fought on the banks of the Char, near Lyme. From the period of the conquest, till the civil wars between Charles and his Parliament, the history of this county presents nothing interesting. During these wars, it adhered zealously and firmly to the side of the king; and the clubmen of Dorsetshire,
as they were called, harassed the forces of the Parliament, long after the rest of the kingdom had submitted to their power. In 1685, the unfortunate Duke of Monmouth landed at Lyme.

The following returns respecting this county were made to parliament in compliance with the Population Act in 1811.

| Houses inhabited | 28,210 |
| Families occupying them | 26,821 |
| Houses building | 171 |
| Families employed in agriculture | 12,890 |
| not comprised in these classes | 4,232 |
| Males | 57,717 |
| Females | 60,976 |
| Total population in 1811 | 124,693 |
| Population in 1801 | 119,100 |
| Increase | 5,593 |

See Hutchinson's History of Dorsetshire; Boswell's Civil Division of the County of Dorset, including a Nomina Villarum; Stevenson's Agriculture of Dorsetshire; Maton's Observations on the Southern Counties; A Sketch of the Geology of some parts of Hampshire and Dorsetshire, by Dr Berger, in the Geological Transactions; and Britton and Brayley's Beauties of England and Wales, vol. iv. p. 821 (w. s.)

DORSETIANA, a genus of plants of the class Triconandra, and order Monogynia. See Botany, p. 126.

DORT. See Dordrecht.

DORT, SYNON. See Ecclesiastical History.

DORANTHES, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 194.

DORYCNIUM, a genus of plants of the class Diaphelia, and order Decandria. See Botany, p. 280.

DOUAY, Douai, or Duacum, is a town in the Netherlands, advantageously situated on the navigable river Scarpe, which communicates by canals with Lille, St Omer, Dunkirk, and the Northern Sea, and by means of the Scheldt with Valenciennes, Cambrai, and Tournay.

The principal buildings are a very handsome square, a fine arsenal, a school of artillery, a lyceum, a society of agriculture, the church and town-house, a public library, a theatre, and a cabinet of natural history. In the church of the village of Loin, which is close to the town, there are many tombs of the middle ages, remarkable for their sculpture. Douay has long been celebrated for its English colleges, to which the Roman Catholics of England were generally sent to be educated.

The principal manufactures carried on at Douay are those of cambric, camlet, woollen and cotton coverlets, flannels, hats, starch, tobacco, oil, soap, earthen-ware, glass bottles, thread, thread lace, and gauze. Two thousand two hundred and four pieces of cambric were annually manufactured here before the revolution, each about two-thirds of an ell wide, and twelve ells and a half long. The annual amount of its linen manufacture was 271,140 francs. There are also at Douay several salt works and houses for refining sugar, a foundry for cannon, and a manufactory for white-iron goods, which are in great repute. Douay is the entrepot for the flax trade, with all the departments of the empire. The canal from Douay to Lille was completed in 1686, by Louis XIV. There are two annual fairs here, the first of which is held on the 1st of August, and lasts only a day; while the second, which is held on the 1st of September, lasts nine days. Population, 18,500. (m) DOUBLE STAR. See Astronomy, p. 680. and 819.

DOUBU. See Electricity.

DOUBUS, the name of one of the departments of France, which derives its name from that of the principal river, which washes it in the direction from south to south-west. It is bounded on the north by the department of the Upper Saone; on the west by those of Upper Saone and Jura; on the south by the department of Jura and by Switzerland; and on the east by Switzerland and the department of the Upper Rhine.

The principal rivers are the Doubs, the Dessobour, the Loue, and the Ognon, none of which are navigable. The two first are scarcely floatable. The Doubs rises in Mount Jura, near Morteau, below Pontarlier, and passes by St Hippolyte, Montbeliars, Beaumes-les-dames, Besançon, and Dole, and falls into the Saone, near Verdun, after a course of about 180 English miles.

The department is diversified by hills and plains. It is almost arid towards Switzerland; but is extremely rich in the canton above the river Doubs, and near its confines with the department of the Upper Saone. It produces wheat, oats, vines and cheese, and affords pasture for cattle. It contains mines of coal and iron, and quarries of marble and slates. The principal iron mines are those situated in the communes Oye, Palaiz, La Cluse, Mijoux, Monperreux, Metabief, Longeville, Noirefontaine, Pont-de-Roide, Cuize, Cutriel, Ornans, Rougemont, La Brethiere, &c. They supply 6 furnaces, 29 small forges, 31 martins, 3 manufactories for iron wire, and 2 foundries. There is also freestone and abundance of turf in the department. The marshes near Besançon, Ruffy, Morteau, Pontarlier, &c. are extensive.

This department has a superficial extent of 5340 square kilometres, and 270 square leagues. The forests occupy 124 or 125 hectares, or 244 or 245 arpents, and belong almost wholly to individual proprietors. The average contribution of each individual to the expense of the state, is about seven shillings sterling. The contributions in the year 1809 amounted to 1,886,853 francs.

The following is a list of the principal towns, with their population:

- Besançon: 30,000
- St Hippolyte: 5,050
- Pontarlier: 3,880
- Beaumes-les-dames: 2,300

Besançon is the capital. The total population of the department is 227,075. See Herbin's Statistique de la France, and Chantreux's Science de l'Histoire, &c. (x)

DOVER, a seaport town of England, in the county of Kent, and one of the Cinque Ports, is situated upon the English Channel, in a valley almost encircled with lofty chalk hills. The form of the town is remarkable, and has a very romantic appearance when seen from the surrounding heights. It consists of three long streets, stretching in the directions, east, south-west, and north, and converging to one point. The town is divided into the two parishes of St Mary and St James, which have churches of the same name.

The church of St Mary's, which is supposed to have been built in 1216, is a spacious edifice. It consists of a nave and aisles, with a tower at the west end, and is about 120 feet long, and 55 broad. The architecture of
the west front is Norman, and likewise the first three arches, and the columns which sustain them on each side of the nave: the two next arches on each side are elliptical, the most eastern one having a very large span. Beyond these, on each side, are two pointed arches of unequal size. The Norman columns have fluted capitals, and most of the columns are large and massive. A very fine organ was erected in 1742. The galleries are large, and the church is well paved.

St James's church, which is of Norman origin, is an irregular building, with a square tower at the west end. It formerly belonged to Dover castle, and the courts of chancery and admiralty for the Cinque Ports are still held in it.

Besides these two places of worship, there are meeting houses for Baptists, Methodists, Quakers, &c.

A new and handsome custom-house has recently been built, and an elegant hospital has been newly erected, near Archcliff Fort, for the soldiery. The town-hall, which stands in the market-place, is adorned with several good portraits, and a curious print of the embarkation of Henry VIII. for France. There are likewise in Dover, a neat assembly-room, a theatre, and two circulating libraries. In the Apollo library, there is a handsome public reading room, furnished with the London papers, with music and musical instruments. A good free school was established here in 1771, and a charity school in 1789.

Dover castle occupies nearly the whole summit of the high eminence which bounds the south-east side of the deep valley in which the town is built. This eminence is steep and rugged towards the town and harbour, but towards the sea it is a precipice 320 feet in height. The castle consists of a lower and an upper court, defended by ditches communicating with the inner towers. The lower court, excepting on the side next the sea, is encircled with an irregular wall, called the curtain, which is flanked at unequal intervals with a number of towers, the workmanship of different ages. None of these towers are supposed to have been built by the Normans. The 1st tower, commencing from the cliff on the western side, is called the Old Tower, and had formerly a gate and drawbridge. 2. Albrancis, or Rokesley tower, is of a pentagonal form. 3. Chilham, or Calderscot tower, is of a square form, and was built by Fulbert de Lucy. 4. Hurst tower, is named after a dependent manor in Chilham parish. 5. Arsic, or Sayes tower. 6. Gatton tower. 7. Peveril, Beauchamp, or Marshall's tower, built over a Saxon gate-way, is connected with a drawbridge, the abutments of which were discovered about 20 years ago. 8. Porth's, Gasting's, and Queen Mary's tower. 9. Fiennes tower, through which is the principal entrance into the lower court; it is generally called New Gate, to distinguish it from the ancient entrance. On the right of this tower are the apartments of the governor and lieutenant-governors, together with an armory of small arms. There are also modern barracks for the soldiery about this entrance. 10. Clopton's tower. 11. Godshoe tower. 12. Crewequer's, or Craville's tower, is remarkably magnificent. There is a subterraneous passage by this tower, leading to a very large vault, which is defended by a moat of prodigious depth, and a drawbridge, and also by a kind of round tower. In an angle opposite to this tower, is an advanced work called the Barbiian. 13. Fitzwilliam's or St John's tower. A spacious sally-port was formerly connected with this tower, and in the underground passage were a gate and portcullis, the stone grooves of the latter being still visible. 14. A common watch tower. 15. A common watch tower. 16. Averancher's, or Mauzel's tower, stands in an angle formed by the curtain wall, and is a fine specimen of Norman architecture. 17. Veerville, or Finsister tower. 18. Goodwin's tower. 19. Ashfordian tower. Beyond this are three other towers, or rather platforms, that have no particular name.

In ascending from the lower to the upper court, the road is steep, and leads to King's Gate and Bridge, forming the entrance to the upper court, which is encircled with a strong wall and numerous towers. On the eastern side are three towers which command the whole vallum and ascent to the principal entrance of this court. The other principal towers, are Suffolk tower, which is a stately fabric and old arsenal tower, and a variety of others which we cannot find room to notice. The keep, or palace tower, which stands in the centre of the upper court, is in very good preservation, and is used as a magazine. The walls are from 18 to 20 feet thick, and contain the galleries. The summit is embattled, and has a turret at each angle. It is nearly 92 feet high, and about 466 feet above low water mark.

When the public were alarmed with the threats of invasion by the French, government erected many batteries for the defence of Dover castle, and furnished them with a formidable train of artillery. They consist of casemates excavated from the solid chalk rock, covered ways, and subterraneous apartments, capable of accommodating 2000 men. A new road has also been made from the town to the top of the hill. Since the renewal of hostilities in 1803, the heights on the western side of Dover have been defended by strong fortifications, connected by the town by a military road. The other fortifications are Amherst battery at the north pier head, and Archcliff fort at the end of the pier.

The harbour of Dover has at different periods received very great improvements, and is now in a very respectable condition. The encroachments of the sea are prevented by several jetties erected towards the cast, and though large quantities of sand are thrown up at its mouth by the south-west winds, yet with the aid of the backwater, the sluices have been able to clear it in one tide. Vessels of 400 or 500 tons may now enter the harbour in safety; there being a depth of 18 or 20 feet of water at spring tides, and of about 14 at neap tides. The piers which form the harbour are very long and substantial, and are defended by strong batteries continued in a chain along the coast, with numerous martello towers.

As Dover is the principal place of embarkation for the continent in time of peace, its trade is very extensive. Before the commencement of the last war, 30 vessels, of 60 or 70 tons each, besides packets, were employed on the passage to the French coast. They were reckoned the handsomest and most commodious vessels in the kingdom. With a favourable wind the passage has often been made in three hours, and sometimes in two hours and 40 minutes. The breadth of the Channel is 74 leagues.

The principal antiquities in Dover, are the Roman pharos and the ancient church which stands on the upper part of the castle hill. The pharos has externally the form of an octagon, and is a square within. Each side of the octagon and of the square is about 14 feet, and the thickness of the wall below is nearly 10 feet. On the east side is an arched doorway about six feet wide, and on the other three sides of the inner square are narrow spaces for windows, about 13 feet in height. This ruin is now in a state of great decay. The roof is
Dover.

Soil. — The soil is chiefly loam, mixed sometimes with clay and sometimes with gravel, having always a considerable quantity of stones in it. The mountainous region of Mourne and Sliebb-Croob is rude and unkindly, scarcely capable of cultivation, though yielding a good deal of rough pasture. Of course there are some parts of it absolutely barren. Near the banks of rivers, the land is principally in the state of meadows, occasionally overflowed, and thus kept in good condition. In the valleys formed by the mountains, there are turf bogs, which, as storehouses of fuel, are valuable to the proprietors. Some of these bogs have, by means of irrigation, been converted into excellent meadow. The climate is sufficiently favourable to vegetation of every kind.

It is impossible that agriculture can be in a very flourishing condition, where land is so minutely divided as it is in this county. Such a minute division, owing partly to the practice of tenants portioning each child with a share of their farm, and partly to the desire of the landlords to increase their political interest, by multiplying the number of freeholders, narrows the field of enterprise and industry. The absence of the most powerful stimulus to skilful exertion, lowers the respectability of the farmer, and prevents the adoption of any liberal and improved system of husbandry. Accordingly, though in particular spots the ground is well and successully cultivated, we in vain look for those results in respect both to quality and quantity of produce, which a knowledge of the natural advantages of the county, combined with a judicious mode of management, would warrant us to expect.

Wheat has been little cultivated in the province of Co. Down, and it is more frequently found on the sea coast than in any other place. Spring wheat has been sown with advantage. A great deal of barley and some turnips are raised. Oats abound everywhere.
Potatoes, of which there are here from twenty to thirty different kinds, are in Down, as in other parts of Ireland, in great request. They are frequently planted in turf bogs and moory grounds, which are thought to preserve them from degenerating; and accordingly, as the curr is in these cases little known, they are sought for seed by those who have not the same advantage. Flax is sown to a considerable extent. In 1800, there were sown with flax 2700 acres, which were supposed to produce 3200 bushels of flax-seed, and of these, bounties were likely to be claimed for 3000 bushels, to the amount of L.750, being at the rate of 5s. per bushel. Of hemp, there are but a few acres in the whole county. Grasses are grown in great variety and plenty. The following Table gives a view of the average quantity of seed and produce of various sorts of grain, taken from different estates and different years.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Seed used per English acre lb.</th>
<th>Produce per English acre lb.</th>
<th>Proportion between seed and produce.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>630</td>
<td>4760</td>
<td>1 to 7.5</td>
</tr>
<tr>
<td>Bear</td>
<td>224</td>
<td>2840</td>
<td>1 to 10</td>
</tr>
<tr>
<td>Barley</td>
<td>542</td>
<td>5600</td>
<td>1 to 10.3</td>
</tr>
<tr>
<td>Oats</td>
<td>836</td>
<td>6860</td>
<td>1 to 8.2</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2800</td>
<td>21,000</td>
<td>1 to 7.5</td>
</tr>
<tr>
<td>Flax</td>
<td>26 pecks.</td>
<td>1440</td>
<td>1 to 53.38</td>
</tr>
</tbody>
</table>

Dung and straw manure is universally employed. Marl has been applied with great success. All along the coast, wreck or sea-weed is used for potatoes, and also in some cases for grain. That species of bog which is unfit for fuel, by wanting the necessary adhesion, is applied to sharp as if clayey soils, both by itself, and after being mixed with lime and dung. Lime, limestone, gravel, and shell sand, also, are made use of in manuring the ground.

Down cannot be considered as a grazing district. Yet many cattle are annually fattened in it; and some of these are of a large size, especially on the western side, where the soil is of a deep loam or clay. In general, bullocks are thought too heavy for the soil, and therefore the grazing stock, for the most part, consists of such calves and heifers as are deemed best for fattening and milking. The farms are so limited, that no extensive dairy is kept, but there is a great number of cows; each occupier keeps at least one, and, as he consumes only the skimmed milk in his family, a large quantity of butter is made, which is partly consumed in the county, and partly exported from Newry and other places. The usual quantity of milk obtained from a cow for two months after calving, is from twelve to twenty quarts. To produce twenty, it requires the animal to be a good one, and to have the best pasture. The breed of cattle in this county is indifferent. Little or no attention is paid to it. The prevalent breed is the long-horned, with their horns growing upwards and thick, having large bellies and thin hips, and weighing between three and four hundred weight. They are good milkers, which is here the great object. Some cattle of a superior kind are to be found in the hands of private gentlemen.—There are no flocks of sheep, except among a very few gentlemen. The little farmers purchase them singly or in pairs at the summer fairs, and keep them one or two years, as they find it convenient, fattening them in the house on boiled potatoes, oats, and hay, and then selling them to the butcher, one or two at a time, as they themselves had bought them. The mutton is said to be remarkably sweet. In the mountains there is a native breed of sheep, small and hardy, most of them horned, who are esteemed for the fineness of their wool, and the delicacy of their flesh.—In the mountainous barony of Mourne, great numbers of horses are bred.—Goats are to be seen around the greater part of the cabins. They furnish the poor people with a considerable quantity of good rich milk.

—Habbits, considered as stock, are chiefly to be met with in the neighbourhood of Dundrum, the sandy soil of which is peculiarly suited to them. They are also to be found in various other places in smaller numbers.

—Bees thrive uncommonly well in this county. The dry hills covered with heath and odoriferous herbs, afford them a rich supply of food, and their honey is here highly esteemed for its flavour.—Pheasants, so scarce in all other parts of the kingdom, abound at Tullamore Park, the property of Lord Roden.

Labour in this county is usually paid in money. The general wages of a man are from 1s. 1d. to 1s. 4d. per day. Few women are employed, except in harvest, when they receive 2s. 2d. per day. A man the year round receives about L.18, and a woman L.9; children per day, 6d. A carpenter per day, 3s. 3d.; mason do. 3s.; plasterer do. 3s.; plumber do. 3s.; tailor do. 3s.; shoemaker do. 2s. 6d.; fiddler do. 1s. 4d.; joiner do. 1s. 4d.; mason per perch 2s. 1d.; slater per square 2s. 6d.; blacksmith per lb. 6d. The prices of articles are as follows:

- Car and horse per day 3s. 3d.
- Saddle horse per day 4s. 10d.
- Plough do. horses and man fed, 5s. 8d.
- Mowing grass per acre 7s. 0d.
- Cow's grass per week, 3s. 1d.
- Horse's do. 5s. 2d.
- Iron per stone 2s. 6d.
- Fencing per perch 2s. 3d.
- Turf per piece 2s. 6d.
- Coal, best Wigan, per barrel 5s. 6d.
- Oak per foot 8s. 11d.; ash do. 5s. 6d.; hickory per thousand L.1, 13s.; lime per barrel 1s. 8d.; car m. L.6, 18s. 3d.; potatoes per stone 2s. 3d.; salt butter per cwt. L.6, 5s.; fresh do. per lb. 1s. 1d.; hay per ton L.4, 5s.; whisky per gallon 9s. 4d.; porter do. 1s. 6d.; ale per quart 4d.; beef per lb. 5s.; mutton do. 7s.; veal do. 8d.; pork do. 4d.; eggs per score 7d.; cheese per lb. 8d.; shoewing a horse 3s.; brogues per pair 6s. 8d.; shoes do. 9s. 9d.; leather per lb. 2s.; salt per stone 1s. 2d.; a spade 4s. 3d.; Swedish iron per cwt. L.1, 8s.; undress flax per cwt. L.4; wool per stone 19s. 6d.; land carriage to Dublin per cwt. 4s. 2d.; fowls per pair 1s. 1d.; a turkey 2s. 10d.; a goose 2s.; wheat per barrel L.2; barley per do. L.1, 2s. 9d.; oats per do. 1s. 6d.; flour, firsts, per cwt. L.1, 12s.; do. 2ds. do. L.1, 10s.; do. 3ds. do. L.1, 8s.; oatmeal per do. 1s. 7d.; rabbits per pair 1s. 1d.; milk per quart 2d.; corn acres of oats per acre L.7, 15s.; of meadow per do. L.5, 13s. 9d.; potato land per do. L.4, 11s.; salt per bushel L.5.

In 1802, Mr. Dubourdieu estimated the average rent of the cultivable land at L.1 per Irish acre; so that, calculating the cultivable land to be 300,000 acres, he made the whole rental of the county to be L.300,000. Since the period at which this estimate was taken, the value of land has been greatly increased; and Mr. Wakefield is of opinion, that taking all things into account, the whole rental may now be set down at double of what Mr. Dubourdieu thought it. Several intelligent gentlemen say, that the average rental of the county may be fairly computed at L.2, 2s. per acre. In 1793, land was let for thirty-one years, or two lives, at 1s. 3d. per Irish acre. Now, it lets at two guineas per acre for twenty-one years. Lord Dufferin lets land during three years for one half the produce. It is thought that Lord Moi-
The principal rivers in this county are the South Bann and the Lagan. The Bann issues from the Mourne Mountains, and, taking a north-west direction, enters the county of Armagh, a little beyond Guildford. Its water is remarkably pure, and esteemed superior to any other for the purpose of bleaching. The Lagan rises in the Slieve-Ricism Mountains, flows in a north-east direction between the counties of Down and Antrim, and loses itself in Carrickfergus Bay, not far from Belfast, from which it is navigable a considerable way up. There are several other smaller streams, which contribute both to the beauty and prosperity of the country. Of these, the most important is the Newry, which rises in the Mourne Mountains, and, after a short course, falls into Carlingford Bay. It is united to the Bann by means of the Newry Canal. Small lakes are scattered up and down. Strangford Lough is a salt water lake, occupying upwards of 25,000 acres, and connected with the Irish Sea by a narrow strait, through which the tide rushes with great rapidity and force. There is no very large harbour. Newry affords accommodation to a good number of ships, and by means of the canal, carries on a great deal of trade. Bangor and Donaghadee are artificial harbours. The ports of Strangford and Killyleagh on the Strangford Lough, and the bays of Killogli and Dundrum, admit vessels of a small size.

Coal, both English and Scotch, is imported for fuel. The latter is made use of for melting. The people prefer turf, on account of its greater cleanliness, even when the coal can be obtained at a moderate price. The demand for it, therefore, is so great, that the bogs, of which there is not a great number, are insufficient to answer it, and it brings a price nearly double of what can be got for it in some other counties. No wood can be afforded for burning. Plantations are scarce, and used as embellishments around family mansions. Here, as in many other parts of the kingdom, there are evidences of wood having abounded in former times. A great many fossil trees have been dug up from the bogs. Of these there are two species, viz. the fir and the yew, which are now seldom or never found growing naturally. The natural wood of the county consists of oak, ash, alder, hazel, mountain ash, birch, holly, white thorn, and the grey willow. The fir, the oak, and the yew, are the only trees which are found in the fossil state, fit for use. There are some oaks in this county which never bear acorns. At Moyallan, oak sells at 6s. per square foot, and ash at 4s. Near Tandragee, an acre of eighty years old timber sold for as much as twenty-five adjoining acres of land. The larch is found to grow well in spots, which for any other purpose are comparatively useless. Evergreens thrive remarkably well, particularly on the coast. Myrtles there grow to a considerable size, though quite exposed even during the winter. Orchards are rather on the decline. In the bleaching districts, a small one is attached to almost every cottage.

Manufacturing is carried on in this county to a great extent. Of the quantity of linen produced, and of its value when fit for market, we have no sufficient data for making an accurate calculation. But some idea may be formed, by attending to the quantity bleached on the Bann in 1808. On an average, the twenty greens bleached 8000 pieces wide each, which makes the whole to have been 160,000. The "ground cost" was £2, 10s. The bleaching cost 8s.; the profit was 8s. per cent. At £2, 18s. the 160,000 pieces would amount to £1,650,000; and if to this be added the 8s. per cent. of profit, the total value of the linens annually finished on the Bann will be £2,060,650. The next manufacture in importance to linen is that of muslin. It was scarcely known about thirty years ago; but it has since that time made a very rapid progress, and arrived at a very flourishing state, though occasionally it has suffered depression. It took away many weavers from the linen business. Besides muslins, of every degree of fineness, and of every requisite breadth, various other stuffs are manufactured from cotton, such as callicoes and wrappings, thicksets, corduroys, and velveteens.

In 1805, the Linen Board paid to Francis Cruikshank a bounty on 16,899 yards of duck and canvass, which at 3d. per yard, amounted to £2.11. 2s. 1d. A weaver of fine linen (in 1802) would make, if he was a good workman, from 1s. 4d. to 1s. 6d. per day; and of coarse, from 1s. to 1s. 5d. The earnings of a muslin weaver, when he had constant employment, was from 1s. to a guinea per week. Machinery for spinning linen yarn was introduced into this country by Mr Cruikshank; and it now supplies the greatest proportion of that article which is used in the manufacture. A very considerable quantity, however, is still spun by the hand, of various degrees of fineness, and of excellent quality. In the Belfast Magazine for 1800, there is an account of the exploits of a woman in Downshire, in this department of industry, which are truly wonderful, and deserve to be recorded. Her name is Anne M'Quillin; she resided at Comber, in the barony of Castle-Reagh. In the time of frost, high winds, and excessive drought, she spins what she calls coarse yarn, that is, from 24 to 36 hanks in the pound. But during mild weather, she can spin to the extent of 100 or 105 hanks, which is equal in length to about 214 English miles out of the pound of flax. Of this latter, she produces a hank in nearly two weeks. A considerable part of the linen yarn manufactured in Down is spun in Tyrone and Derry.

Herrings have been frequently caught in great numbers in Strangford Lough; but they were not so good either in point of fitness or flavour as those taken in the main sea. They sometimes come close to the shore, but generally they are found towards the Isle of Man, where the boats from Newcastle pursue them. These are excellent in quality. Many of them are brought to Down, and sold through the country by the fish carriers. The coast of this county abounds with whiting, gurnard, sea-trout, mackerel, and haddock. About the Copeland Islands, which lie off Donaghadee, there is found a small red codling, which is better tasted than the common cod, but does not answer so well for salting. At Bangor, there is a fishery of sole, plaice, and turbot; and, in winter, of cod and oysters. From various quarters, boats come and trawl in Dundrum Bay for turbot, sole, plaice, cod, and haddock, of which they carry off large quantities. In all this fishing, the inhabitants of the coast of Down have very little share. They neither have sufficient enterprise nor proper apparatus, otherwise it might be a valuable source of subsistence and wealth to them.
got in the barony of Mourne, the lordship of Newry, and in part of Upper Ivecagh. Along the face of the mountains there are several quarries of it, and, from the little river Annapolis, it is exported to other places on the coast. There is also excellent freestone, the chief quarries of which are those of Scraba, near Newtown, and those of Kilvarin on the road from Hillsborough to Moira. This slate furnishes very large slabs of different colours. There are some of a clear stone colour, very hard and very beautiful. A stone taken from it for a step to the communion table of Hillsborough church is 22 feet in length, and two in breadth. There are quarries of excellent slate, which are wrought to great advantage. At Crayleuth there is a black marble, exceedingly fine, and susceptible of a very high polish. There are mines of lead which were worked formerly, but are not worked now, at the Blundell estate at Dundrum, and also at Clonliffe, between Newtownards and Bangor. Copper ore has been said to have been found. There is coal too, but no encouragement to work it. This county contains, besides, ironstone, fuller's earth, soap-stone, and crystals. There are some mineral waters, both sulphuraceous and chalybeate; those near Ballinlough are most frequented.

Weights and measures. Wights and measures in this county, as in others, are various. In the neighbourhood of Guildford, the cwt. is 112 lb.; at Dromore it is in some cases 112 lb. and in others 120 lb. In the latter place the bushel is equal to 10 bushels, and the bushel to 32 quarters. The following is from Dubourdieu's Survey of Down: cwt. = 8 stone; stone = 14 lb.; ton = 20 cwt.; bushel = 32 quarters = 1 gallon; 1 hhd. = 12 Winchester bushels; hald = 10 Winch. bush. Oatmeal is sold by the cwt. of 120 lb. potatoes by the stone of 1 lb.; undressed and heelked flax by the stone of 16 lb.; beef and pork, when sold by the cwt., have it at 120 lb. tallow, per stone, of 15 lb.; hides, per cwt. of 120 lb. Oats are now only the grain sold in this country by measure.

Political divisions. Down contains, besides the lordship of Newry, eight baronies, viz. Upper Ivecagh, Lower Ivecagh, Kinealtry, Castleragh, Dufferin, Ardes, Lecale, and Mourne. In these there are sixty parishes. It is used to send in all 14 members to parliament. Since the union it returns only four, two for the county, one for Newry, and one for Downpatrick. The county freetholders are no fewer than 30,000. These elect, without a contest, whatever persons may be nominated by the Marquis of Downshire, who has divided and subdivided, and again divided his estate, so that it has become, what Mr Wakefield terms, a warren of freetholders. There are two regiments of militia, North and South Down.

The farmers and peasantry, with few exceptions, live in smoky huts, are extremely poor, and dirty and slovenly in their habits. A considerable improvement, however, in the modes of living has taken place of late years, and it is gradually advancing, though that advance must be slow, while proprietors continue to consider their tenants as mere engines of parliamentary and political ambition, and do not themselves lead the way to plans of amelioration. That part of the county which comprehends Hillsborough, Banbridge, Moyle, and round towards Newry, is inhabited by a middle class of opulent manufacturers, whose dwellings are neat and comfortable, and whose general circumstances exhibit evident symptoms of industry, civilization, and contentment.

According to Dr Beaufort, this county, which is all in the ecclesiastical province of Armagh, contains almost the whole of the bishopric of Dromore, viz. 22 parishes, having 23 churches, and extending over 143,700 Irish acres. The chapter is composed of a dean, precentor, chancellor, treasurer, archdeacon, and one prebendary. The lordship of Newry claims an exemption from Episcopal jurisdiction; and the proprietor of the lordship holds his own peculiar court, granting marriage licences, probates to wills, &c., under the old monkish seal. The bishop resides near the town of Dromore, not twenty miles distant from any part of the diocese; he has 23 parishes in his gift. In 1779, his revenue was about £2,200; it is now £4,500. The bishopric of Down and Connor were united in the year 1454. Of Down, only a small part of one parish is situated in the county of Antrim, all the rest, consisting of 38 parishes, having 35 churches, and covering 201,150 Irish acres, is contained within the county of Down. The chapter is composed of a dean, precentor, chancellor, archdeacon, and two prebendaries. Of Connor, there is only a part of one parish, extending to 37,000 Irish acres, in this county. In 1779, the bishop of Down and Connor had a revenue of £2,500; it now amounts to £5,000. He has in his gift 15 parishes in the diocese of Down and 38 in Connor. In the year 1790, the deanship of Down was worth only £2,500 per annum. It now lets for £3,700. Of the Protestants, who amount, according to the estimate of Mr Wakefield, to about one half of the population, the greatest part are Presbyterians. The Antiburgher Seceders have six congregations at the following places, Bally-Copland near Donaghadee, Newton Ards, Gilneekirk in the parish of Castle-removed, Hill Hall near Lisburn, Moira and Newry. There is also a considerable number of Quakers, and the Methodists are gaining ground. In some parishes there is not a family belonging to the established church. In some parishes also between Lisburn and Belfast, and along the southern shore of Belfast Bay, there is not a Catholic family, nor almost an individual who is not a Presbyterian. The people who inhabit the mountains, and the poorer classes in many other places, are of the Catholic persuasion.

Mr Byrne, a merchant in Dublin, has an estate here of £3,000 per annum, and is the only Catholic proprietor who possesses a qualification for being put on the grand jury. The yeomanry and higher ranks of this county, who have among them an Orange party, are very hostile to the claims of the Catholics, on whom they are too much accustomed to look as beings of an inferior order.

The county of Down is in length from north to south 51 English miles, and in breadth from east to west 39.5. Its area is 574 square miles, or 559,995 English acres. It contains 36,636 houses, which at 5½ to a family, give 201,408 inhabitants. At this rate, there will be about 15,28 acres to a house, nearly 42 houses to a square mile, and about 2.77 souls to the English acre. This is Dr Beaufort's statement. In 1751 the number of houses was 19,570, and in 1791, by a return of government, it was 38,351. Allowing, as Mr Dubourdieu does, 5½ persons for each house, the population, in the former year, would be 101,167, and in the latter, it would be 201,342. In the parish of Annahill he found, on enumeration, that there were on an average, 3½ to a house: There were 400 houses, and of course 2100 inhabitants, of whom a proportion of 6.5 or 318 were liable to serve in the militia. According to this estimate, he makes the population of the whole county to be 280,447. Mr Woods, a dissenting clergyman, gives the following return for the parish of Bangor: He says
that it contains 7000 Irish, or 11,340 English acres; that there are 6550 inhabitants, and that the annual births are 560. He adds, that this may be taken as a pretty fair average of the county. So that, at this rate, the population of the county would be 322,466; the number of individuals to an acre would be 1.78; and the annual births would amount to 17,777. This estimate is so different from the other, in which the number of houses is given on good authority, that it cannot be considered accurate. Indeed, it is next to impossible to say whether any one parish or small district can be taken as an average, in any one particular, of a whole county such as that of Down. In the town of Portaferry, there are 117 houses, and 525 inhabitants, which being only 4.5 to a family, makes the population of the county, at the rate of 38,351 houses, to be only 172,579. The return of the inspector-general of hearth money, in 1791, bears, that in the county of Down there were 38,551 houses, of which 31,147 had one hearth, 1974 had two, 483 had three, 235 had four, 148 had five, 89 had six, 42 had seven, 34 had eight, 13 had nine, 25 had ten, 67 had more than ten, and less than forty-four, 1118 were exempted as new, and 5977 as paupers.

See Beaufort's Memoir of a Map of Ireland; Newenham's View of the Natural, Political, and Commercial circumstances of Ireland; Dubourdieu's Survey of the County of Down; and Wakefield's Statistical and Political Account of Ireland. (r)

DOWNPATRICK, the chief town of the county of Down, in the province of Ulster, Ireland, is situated about six miles west of Strangford bay, and is encompassed by hills on the east and south, which confine the view to a small but pleasing extent. Near the town is a high hill, that commands an extensive prospect of the neighbouring country, and the river Koll, which is here seen advancing towards the town, under the noble hanging wood of Pontallagh.

It is a post, and borough town, and returns one member to the imperial parliament. It has a good linen market, and commands an extensive trade with the neighbouring country, which receives considerable advantage from its contiguity to the sea, having thereby an opportunity of exporting great quantities of potatoes and malt.

This town has long been celebrated as the burial place of St Patrick, and is reckoned one of the most ancient towns in Ireland, being noted in history before the arrival of St Patrick. Its present name signifies the mount of Patrick, which has been given to it from the Dun, or Ruth, which stands on the north-west of the town, the conical height of which is 60 feet, and the circumference 2100 feet; it is surrounded by three great ramparts, one of which is 30 feet high; and the whole circuit of the works is three quarters of a mile. This mount is supposed by some antiquaries to have been the chief residence of the kings of Ulalgh, or Down; others are of opinion that it was erected by the Danes, who made many predatory excursions to this coast during the 7th, 8th, and 9th centuries. In the neighbourhood of the town is the famous St Patrick's Well, commonly called Stateur, which the ignorant believe possesses many healing virtues, and at a certain season of the year it is much frequented by some of the superstitious Catholics, who perform their penance by going round it a number of times barefooted, or on their knees. The ancient abbey of Canons Regular stands near the town at the ascent of a hill, and was founded, it is said, by St Patrick, whose remains, tradition says, were interred here in A.D. 493; and in the year 1125, the bodies of saints Patrick, Columb, and Briged, were said to be discovered in this abbey, with the following epitaph written over them:

Hi treis in Duna tumulo tumdenter in uno, 
Brigida, Patricius, atQ. Columba Pru.

The cathedral stands at a small distance from the abbey, and was made the seat of a bishop by St Patrick. Near the abbey stood a round tower, about 70 feet high, which was probably used for a belfry; this tower was taken down some years ago, in order to enlarge the west end of the cathedral. The celebrated De Courcy, the first earl of Ulster, took possession of Downpatrick in the latter end of the 12th, and the Scots, under Edward Bruce, destroyed it in the beginning of the 14th century. The destruction of the cathedral of Down, in 1538, was one of the articles of impeachment against Leonard, Lord Gray, but it has been lately rebuilt: and it is worthy of remark, that the workmen, while repairing this church in 1789, discovered a stone coffin, the inscription of which was obliterated by the consuming hand of time, and found the bones of a skeleton firm, and most of them adhering together, in the same posture as when interred. On the legs appeared half boots, and the length of the skeleton was above seven feet.

The bishop's see is united to Connor, in the county of Antrim, and forms the bishopric of Down and Connor.

The town is tolerably large, containing four long streets, and many lanes. The number of inhabitants is about 5000. There are four houses of public worship, an established church, a Presbyterian meeting-house, a Roman Catholic Chapel, and a Methodist meeting-house. This being the assize town, it has a good county jail; there is also a county infirmary, and a small hospital, endowed by the De Clifford family for the support of the indigent, and the education of a few boys and girls. Its other public buildings are respectable; and the many antiquities of which it boasts are well deserving the attention of the curious. It is 20 miles south east of Belfast; 24 east north east of Newry; and 74 north by east from Dublin. West Long. 5° 39', North Lat. 54° 28'. (o)

DRABA, a genus of plants of the class Tetradyinia, and order Siliculosa. See Botany, p. 259.

DRACAENA, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 189.

DRACHM. See Money.

DRACO. See Herpetology.

DRACOCEPHELUM, a genus of plants of the class Didynuma, and order Gymnospermae. See Botany, p. 246.

DRACO CONTIUM a genus of plants of the class Hepandria, and order Monogynia. See Botany, p. 198.

The art of draining off the superabundant moisture from watery lands, so as to fit them for the operations of Agriculture, &c. We have already, under that article, detailed some of the modes of effecting this object; but as the subject constitutes one of the most valuable of rural improvements, and seems worthy of more minute detail, our intention, in the present article, is to give a more complete view of the principles on which the art depends, and their application to some of the most important cases of practice.

In all periods of our history, this subject appears to have attracted much of the attention of the legislature. Recitals of numerous enactments concerning drainage, may be seen in Dugdale's History of Embanking and Draining, and a particular account of the great national project for gaining the level of the fens in the east of England.

At a much earlier period, the Romans appear to have executed many works of the kind. The innings of Romney Marsh, the pattern for all our other reclaimed fens, is distinctly referred to that enterprising people. The foss-dyke in Lincoln, and many other ancient lobes and drains, were the work of their legions during the intervals of active war. The Frisian and Saxon colonists also, from the watery flats of the north of Germany, seem to have bestowed much labour in freeing the low grounds of England from the risk of inundation, to which vast tracts appear to have been liable in their natural state, and are even yet only barely out of the way of the water.* The feudal system and petty jurisdictions were particularly favourable to the management of works of this kind, and perhaps a proper equivalent has not yet been substituted for them in our modern policy. In England, however, particular codes of laws have been formed for this object, and commissions of sewers are numerous, and of great antiquity. Scotland, from its more uneven surface, and its frequent troubles, appears to have attended but little to this species of improvement; while Ireland, until of late, seems rather to have been retrograde; for if we may judge from the appearance of some of the bogs, the morasses of that kingdom have even extended since the introduction of agriculture. And though many vast tracts of that fertile island are either quaking bogs, or flats frequently covered with water, no commission of drainage was to be heard of in the kingdom, until lately, that, by authority of Parliament, a board of commissioners was formed to enquire into the nature and extent of the bogs in Ireland, and the practicability of improving them. They have already published two reports on the subject, containing much interesting matter, exhibiting the present state of the bogs in certain districts, and evincing clearly the practicability of converting these unprofitable wastes, at a small expense, into the state of arable and pasture land.

This example should stimulate the landholders of Scotland to institute similar enquiries respecting the waste lands of their country, the value of which is but little understood, though they are of much greater extent than those of the rest of Britain and Ireland; and there are political as well as moral reasons, which would make the legislature readily attend to, and second any well digested plan for their improvement.

By far the greater part of these wastes are covered with moss or peat of more or less depth; a beneficial provision which nature has made, to facilitate the operations of agriculture on soils that would otherwise be barren. All that is requisite, is to free them from superfluous water, which, in general, may be done at an expense comparatively trifling, and the application of other substances will then render them permanently productive. It is the business of the engineer to show how these operations may be facilitated; for, without regular and systematic management in great operations of this kind, there is always a loss of labour and time, and a diminution of effect.

Though this subject constitutes one of the most useful applications of the principles of hydraulics, it is surprising that so little attention has been paid to it by scientific men. Until lately in this intelligent and rapidly improving country, we had no such thing as any treatise on the art of draining, which, by laying down a few fixed principles, could enable the intelligent farmer to comprehend the cause of the evil that annoyed him, and to proceed at once in an unerring manner to its cure. All books of husbandry indeed profess to treat of draining, and, confessing its importance, proceed to give directions for performing it. But these books being, in general, written by men ignorant of hydraulic principles, contain only the results of rude experiments, directed by the random notions of farmers, groping about with enormous expence and labour for what a person of tolerable intelligence should have perceived at first. To what other cause can we ascribe the enormous ditches that are to be found in some quarters of these kingdoms; the multiplied hollow drains in others; the absurd directions or useless positions in which they are often laid, rendering them rather nuisances in a field than a benefit. Their consequent destruction and renewal has, in many instances, rendered the drainage of a field by far the most expensive operation connected with its cultivation. To this chiefly we must ascribe the immense tracts of watery land which yet lie waste throughout the country, the reclaiming of which would doubtless be the most profitable kind of agricultural undertaking that could be thought of.

The species of lands that admit of improvement by drainage, may be arranged as follows:

1st. Watery flats; comprehending fens, wet bottoms, marshes, (and even lakes and pools,) on which the surface water collects in wet seasons, by reason of the obstructed out fall, but which deliver the water from their surface as soon as a proper out fall is provided for them. The mode of relieving these may be named Surface draining.

2d. Morasses, or morses, as the bogs of Ireland, the moors of Holland and Saxony, which have commonly a sufficient fall, but on which a thick covering of vegetable matter has formed a soil retentive of water like a sponge; and with these also may be classed the deep

* The bogs and morses are most numerous on the western sides of these kingdoms. Does this arise from the eastern settlement of the Belgians and Gothic tribes, (an agricultural people), the nature of the soils, or the moisture of the Atlantic?
Draining.

**Draining.**

64

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DRAINS.

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retentive clays, or other poaching soils upon retentive bottoms, forming cold or wet lands, which, as far as drainage is concerned, are very similar to the former. These grounds are relieved by proper management of the subsoil; but, in treating of that division, we shall take a view of the distemperature of soils in general, as well those that suffer from drought as from abundant moisture.

3d, Springy grounds, such as bogs, quagmires, and quicksands, which arise from subjacent waters, and are relieved by draining the strata or bottom.

**Chap. I. Of Surface Draining.**

The principles upon which the drainage of low grounds depend are few and simple, and may be readily comprehended, by attending to the ramifications of rivers and streams, which are the natural drains of every country.

The lowest attainable outfall must first be discovered, and, if otherwise unobstructed, a main drain led up from it into the space to be unwatered. From this, there should be branches drawn into those which are not commanded by the main drain alone. The junctions with the main drain should be oblique, and pointing down the stream, that the influx of side waters may not tend to dam up those of the main. Into these branches, the fence drains of the fields are conducted in inclosed grounds, and the land is laid up in ridges and furrows, terminating in the boundary fence drain. Where the furrows are so situated as to run across a hollow, the waters of which they are not deep enough to discharge, the water furrow becomes necessary, and is drawn across them in the hollow ground, so that a general vantage may be gained to every part of the surface by an unobstructed fall, which is greatest at first, but may be gradually diminished, as the quantities of water increase, by uniting until the whole is discharged into the sea.

In searching for the lowest outfall, the spiral level must often be resorted to. There are, however, natural marks, by which the fall of the ground, and consequent direction of the flood waters, may be discovered in the flat countries. On examining the ditches, which become nearly dry in summer, it will be found that the leaves of the various aquatics, as the sisyrium, the water cress, the veronica, or brook lime, &c. invariably point down the fall, or in the direction to which the water passes. This observation is well known to practical drainers. It should always be kept in view, as the situation and direction of these plants will afford, in many cases, a more ready means of discovering the direction of the natural hollows than any other. During flood also, it is of consequence to mark the progress of the waters in their increase and diminution; and it is often advisable while they are stationary on the flats, to sound them, by inserting many pegs in the ground, so as to have their tops level with the water, by which means the heights and hollows are at once perceived by the different lengths of the pegs. This method is particularly convenient in laying out fields for irrigation by flat flooding.

With respect to the inclination or slope of drains, there are certain limits which must not be exceeded; the slope must be such as will at least permit the water to be carried off with sufficient rapidity to keep its channel clear, but not so fast as to injure it by acting on the sides or bottom. Mathematically speaking, the water should pass away with any the smallest inclination of channel, and even gradually accelerate in velocity.

But we know that in fact this tendency to accelerate is speedily destroyed by the friction and other obstructions in the channel, and these increase in proportion to the smallness of the quantity of water, so that great rivers are enabled to move with less declivity than is required for smaller streams. This has not been sufficiently attended to in the operations on the great English fans; for, instead of uniting the upper waters into one capacious river, they have been divided and led away to different outfalls, greatly to the injury of drainage.

**1.** Large and deep rivers run sufficiently swift with a fall of about 1 foot per mile, or . . . . 1 in 5000

**2.** Smaller rivers and brooks, with a fall of 2 feet per mile, or . . . . . 1 in 2500

**3.** Small brooks hardly keep an open course under a foot . . . . . 1 in 1200

**4.** Ditches and covered drains require at least 8 feet per mile . . . . . . 1 in 600

Furrows of ridges and filled drains, require much more.

The elevation of ridges measuring across, is, according to the soil, sometimes as high as . . . . 1 in 10

Where the ground is level, and there is not in the direction of the smaller drains a fall equal to the above, it may be given in the formation of the drain itself, by cutting it deep at the outfall, which is preferable to widening merely.

The limit to the increase of the fall depends on the cohesion of the stuff in which the drain is cut. Firm rocky bottoms may be supposed to bear water passing over them at any slope; but, independent of the old adage, that even the drop wears the stone, the boulders, &c. which are likely to be brought down by swift running streams, are, by their battering and rubbing, equal to the destruction of the hardest rocks; hence the beds of mountain torrents are cut to great depths even in strata, which appear able to withstand the effects of water for ever. The stream will sweep away the substances that form its channel until it leaves only those which have a gravity in proportion to their weight and figure, just sufficient to counterbalance the impulse which it communicates.

Now, the figure of the pebbles being supposed the same, the weight of larger masses is greater in proportion than the surface on which the water acts. Thus, a pebble of twice the diameter, has four times the surface, but eight times the weight. A table might therefore be formed, which would exhibit the nature of the bottoms of streams of any given velocity. Such a table the reader will find in the article Bridges in this work, being there intended to enable the builder to discover the velocity of a river by inspection of the bottom. But for the purposes of the drainer, it is to be wished that a similar connection could be shewn between the slope of the channel and the nature of the bottom which will admit of it. Now, from what has already been said, it will appear that this must mainly depend on the quantity of water which passes in the channel, since we perceive that there is required for good drainage a fall no less than eight times as great in the small drain than would be requisite for the large and deep river. The following Table may, nevertheless, be of some service; it is drawn from observation on somewhat larger quantities than usually require to be artificially conducted. The windings of the channel and depth of water will, however, make great variations from it.
DRAINING.

Table of the Fall or Slope, and Nature of the Bottom of Rivers and Streams.

<table>
<thead>
<tr>
<th>Fall of rivers and streams</th>
<th>Bottom.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 10</td>
<td>Rock</td>
</tr>
<tr>
<td>30</td>
<td>Large stones</td>
</tr>
<tr>
<td>50</td>
<td>Smaller stones</td>
</tr>
<tr>
<td>70</td>
<td>Pebbles</td>
</tr>
<tr>
<td>100</td>
<td>Small Pebbles</td>
</tr>
<tr>
<td>200</td>
<td>Very small do.</td>
</tr>
<tr>
<td>400</td>
<td>Fine gravel</td>
</tr>
<tr>
<td>600</td>
<td>Coarse sand</td>
</tr>
<tr>
<td>1000</td>
<td>Common sand</td>
</tr>
<tr>
<td>2000</td>
<td>Muddy sand and clay</td>
</tr>
<tr>
<td>4000</td>
<td>Mud and soft clay, some river</td>
</tr>
<tr>
<td>6000</td>
<td>Weeds at bottom</td>
</tr>
</tbody>
</table>

The above Table is calculated for small rivers and brooks, as already observed. Rivers would require less, and small streamlets and drains more descent, to have the same velocity and description of channel. Straight and even channels also permit the water to flow much swifter than where it has, with the same slope, to wind round the different sinuosities of the natural bed, to pass over shoals, or through narrow, &c.

It may be observed, that a bottom of fibrous bog will bear a greater velocity than any loose earth or gravel. The intermingling of the fibres prevents them from being torn away. Accordingly, bog drains stand well, even upon great slopes, if they are not cut to the under stratum; but where that is the case, as it is generally found to be gravelly or sandy clay, the bottom swiftly gives way with the stream, and the drains choke, or blow up if they are hollow. It appears, therefore, not only advisable, but even highly necessary, to draw in sloping ground the drains across the slope, so as to be nearly on a level, since a fall of 1 in 630, the greatest that is absolutely necessary, is not sensibly very different from the horizontal. This disposition of the drains at the same time enables them to catch and collect the water as it descends through the soil down the slope, and prevents the same water from successively moistening lower and lower pieces of ground. This principle, however, is by no means generally understood by common farmers, among whom, in many cases, the only idea seems to be to carry away the water as fast as they can; and this they attempt by perpendicular parallel drains running down the slope, or by many branches collecting rapidly into one main down the hollows. They do not observe, that, in these cases, the water which falls on the field, unless it happens just to fall over one of the drains, is not in the smallest degree assisted in its passage away; for it will most probably descend through the loose arable soil, until it comes to the firm bottom, and then, as it can have no tendency to proceed sidewise into any of the drains, it must continue to trickle down the slope until it arrive at the bottom, in which situation a drain, though it may perhaps afford it a more unobstructed passage, can give no more fall than originally existed on the surface of the field. And hence, by the way, the propriety of rounding the ridges, that there may be a fall either way into the furrow from the crown; and upon which point it may be noted, that if the ridges are laid to come right down the slope, there can be very little use for furrows at all. In such cases, if it is not otherwise inconvenient, the furrows should be drawn obliquely across the slope, and, acting as catchwaters, would greatly diminish the number of hollows that would be requisite in an arable field. But more of this by and by.

The dimensions of open drains will chiefly depend on the nature of the soil, and quantity of water to be conveyed by them. The best form for facilitating the passage of the water, is to make the slope on each side 16 inches of base to a foot of perpendicular height; the breadth at bottom may be two-thirds of the depth of water, unless particular circumstances make it desirable to widen the channel so as to lower the surface. As to water-way, we have usually found the channels of rivers and streams running about two feet per second to contain about a square foot area of section for each hundred acres of drainage; but this will vary according to soil and climate. The usual size of the smaller ditches running through farms are three or four feet deep; but it is difficult to preserve the sides so steep. The drainage of every kind of ground is effectual, when the water is two feet within soil.

When the site is liable to be injured by foreign waters descending into it from the conterminous upper grounds, it is most advisable to cut them off at higher levels, before they descend into the flats, which, by this means, will have only their own waters to discharge. For that purpose, the catchwater drain must be resorted to, being drawn along the boundary of the upper grounds, so as to intercept the springs and streams flowing from them, until a convenient opportunity be found of discharging them into the receiving stream. It frequently happens that the water which is thus procured affords sufficient power to work hydraulic machinery, by which the neighbouring low lands may be freed from their proper waters, even when they have no natural outfall.

When the natural channel of the foreign waters lies through the site to be drained, as is the case with most rivers which overflow their low grounds, it is commonly necessary to confine them with embankments on either side, to prevent inundation in time of floods. The size and dimensions of the embankment must depend on the depth of water and reach of the waves to which it may be exposed. They must not only be high enough to keep out floods equal to the highest previously known, but also those which may occur after the space over which they used to spread has been diminished by the embankment. The floods of all rivers increase after embankment, since they are not only deprived thereby of a certain portion of channel, but also of those natural basins or reservoirs which used to receive the surplus waters of sudden swells, and of course regulate the supply to the lower reaches of the river.

Where long-continued floods keep the water for many days above the level of the neighbouring lands, it becomes advisable to puddle the embankment, or to carry up a wall or partition of impervious stuff in its middle, to prevent the transpiration of the waters. It is necessary that the puddle wall be inserted a foot or more under the original surface, as the waters in that case, having a greater space to pass through under the foundation cre there can rise again on the inside, are likely to choke up the several pores by their sillage more effectually.

The exterior slope of embankments should be at least twice the height. Even three times or upwards is advisable, when a reach of wave is to be resisted; but these slopes are seldom given, and hence the frequent failure of such structures.

The thickness at the top of an embankment may, the-
DRAINING.

Draining.
Embankments.

ritically speaking, be reduced to nothing; for, as it exceeds the height of the water, it has nothing to resist. But it is frequently used as a foot-path, and on the slightest banks cannot well be less than two feet. Six feet is a more advisable breadth for the banks of small rivers. The dikes of Holland are 18 ells at top, and are used as roads.

The inside slope of a bank is of less importance. About one foot of base to one of perpendicular is a pretty natural slope for most earth; but where faced with sods, it may be much steeper. Some advantage is thought to arise from making the face of the bank concave, as the settlement of the earth will be thereby lessened. We shall hereafter take an opportunity of giving the reader an investigation of the principles on which the form and thickness of dikes depend; it is a particular case of retaining Walls for supporting earth, running sand, or water. In the mean time, we offer him the following from Silberschlag Theorie des Fleuves, p. 72.

Table of the Dimensions of Embankments.

<table>
<thead>
<tr>
<th>Height of Waves</th>
<th>Thickness at top of bank</th>
<th>Slope on land side per foot of height</th>
<th>Slope on water side per foot of height</th>
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<tbody>
<tr>
<td>1 foot</td>
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<td>9</td>
<td>15</td>
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<td>10</td>
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</table>

It is proper at all times to turf over the surface of an embankment; and should the exterior side be exposed to waves or rapid currents, additional precautions become necessary, as piles and planks of timber, or walls of masonry. In the latter case, it is highly useful to stop the open joints with heath and moss, which collect the silt, and lighten the dike; but in most situations where these embankments are made, stones and timber are of doubtful benefit, and the turf, being formed on sandy soil, has little adhesion.

The Dutch, their great masters in this art, were led, by many fatal accidents, to adopt a method of covering the front of their sea-dikes in particular, which may be called thatching them, with straw. The men employed for this purpose, kneel down on the bank, with their backs to the sea, and have beside them bundles of straw, of which they make ropes of an inch or two in thickness. When they have twisted about a foot of this, they press the middle into the sand of the dike, by means of a forked stick. The straw rope is then prolonged, and at the distance of about five or six inches it is pressed again into the dike; and thus they continue from the top of the dike to the bottom. Another rope is then worked in alongside of the first, and so on along the bank, the ropes being laid as regularly and close as in a beehive.

The quantity of straw consumed in this operation of thatching the dikes is, as may well be judged, very great; and magazines of it are everywhere kept in readiness, and regular overseers are in constant employ-

ment, to look after those structures on which Holland depends for existence. The grass springs up between the straw ropes, and after some time entirely conceals them; but they require frequent examination, and whenever they are rotten must be immediately renewed. A man covers about 800 feet per day.

Bulwarks of stone are frequently employed as a facing for dikes, but very injudiciously, being soon gulled out and thrown down. Courses of brick are employed with better effect, or a smooth covering of gravel, the slope of the bank being made so gentle as to admit the gravel to lie steadily. A very effectual facing is also made by fascines, or faggots of brushwood. Small osiers and aquatic brushwood planted along the foot of the slope, are a good defence against ice.

Where embankments are made on mossy soil, bog, or soft fen, they should have a base sufficiently wide between the ditches; as we have seen for want of this precaution, great lengths of dike overset or buried at once, by the ditches bursting in. In such cases, the soil, if possible, should be formed by attrition, or warping by alluvial silt; the counter-ditches cut shallow and at a good distance fromer, and if possible, they should be allowed to run for some time, so as in some degree, to drain the ground ere the embankment be completed. Should this be impracticable, a thin wall of turf between a double row of plank piling may do, until the interior area be dry, and firm enough to bear a stouter embankment.

The drainage of the embanked land is now to be provided for; it is conducted upon the principles already set forth. When an outfall sufficiently low can be found, a back drain runs along the inside of the embankment, until a proper opportunity occurs of discharging it. For that purpose it is sometimes necessary to convey the channel under the bed of the river itself, or some embanked branch of it, which is done by means of a pipe of stone or timber, called a fox, or culvert. The form of these will be described in the article INLAND NAVIGATION.

Where the embankment is only against floods or the tide, an opening is made through the bank itself to shut with a valve or floodgate against the exterior high waters, and which being opened when they have subsided, permits the internal waters to escape. In cases where this is not practicable, the waters must be lifted by artificial means over the bank.

Flood-gates are variously constructed: the simplest for our purpose is a valve or clapper, hanging by the top, and falling against the end of a pipe, or against a sluice frame; at other times sluices or paddles are made to slide up and down in a grooved frame; and in greater cases, butting gates are hung so as to shut against each other in the middle like folding doors, or to turn on a horizontal or vertical axis, by some of which a body of water is at times collected and discharged, so as to clear the mouth of the channel from obstruction. When this outfall is situated on a shifting beach, it is often advisable to protect it by a pier or jetty of piles, &c. and to remove the gravel or sand which this may accumulate as often as appears necessary, or to form a covered channel through the whole line of beach into deep water. Much may, however, be effected by the judicious position of the outfall, with respect to the currents, that it may not be warped up by the deposits from the river or sea, but rather swept clean. In dangerous cases, and exposed situations, a second valve is sometimes formed on the inside of the first; and by the admission of a certain
portion of water between them, the pressure on the exterior one is diminished. A good instance may be seen at Lossiemouth, in Morayshire, upon the great exit which has drained the Loch of Spey. Many other precautions are requisite for the security of these sluices; but we cannot particularise them here. When there is no natural outfall, the waters are lifted over the bank by machinery of various descriptions. The marsh-mill of the eastern fens, is a windmill, having a body of brick about 20 feet high. The axle of the sails, by two bevel wheels, communicate motion to an upright shaft, on the lower end of which a horizontal wheel moves another vertical wheel; on the outer end of the axis of this last, is a small water wheel, similar to that of an undershot mill, working in a case of wood or stone, and with a valve drain at the head; the little water wheel is thus driven against the fall, and throws up the water three or four feet, which permits its escape into the river.

When a fall of water can be had, a very simple marsh mill is formed by two water wheels, on one axle of which one is driven by the fall of water, and the other acts as usual, in lifting the water over the bank. The current of the river is sometimes used as the moving power: though this is not advisable, great benefit may, however, in many cases, be derived from the rise and fall of the tide. If the drains fall freely into the brook, the brook into the river, and that into the sea, nothing further need be wished for; but it often happens that one or other of these is so obstructed, as to cause injury to the lands above. The new channel, or operations for the amendment of the old, must be frequently executed on property which has no immediate prospect of advantage from the undertaking. Hence it becomes necessary to have legal authority for this purpose, and to form commissions of drainage, which, in order to do their business with effect, should have cognisance of the entire river or district, and of all the baron of land which is drained thereby; and they should have power to assess individuals or communities, according to the benefit received by the improvements which they effect.

Romney Marsh is governed by 24 jurors and a common bailiff. If any person should refuse or neglect to make necessary repairs, the bailiff does them at the oversight of the jurors, and charges double on the defaulter; the surplus goes to the fund for banks and repairs; the defaulter may be distrained for the same within the marsh.—35 Ed. III. Forty shillings per acre is the price paid for land taken for banks, ditches, and water gangs,—35 Ed. III. The bailiff and jurors were incorporated by Edward IV.

In a session of Sewers at Hfords, in Essex, 19th April 1639, an order is recited for raising L. 1706, to repair a breach in the banks at Bromley; and upon the neglect of certain persons to pay their quota, a lease for 41 years is made of several parcels of land belonging to them, unto others at a pepper corn rent.—Papers in Petty Bag Office.

Where any person, assessed by commissioners of sewers to any lot, and refuse or neglect to pay the land to be leased, or passed in fee simple, to recom pense the undertaker.—13 Eliz. cap. ix.

Chap. II. Of Subsoil Draining.

It is not enough to discharge useless waters from the surface of the land, we must also remove them from the plant bearing soil, if we wish it to produce any other than useless aquatics. In retentive bottoms, this is effected by drains in the subsoil or stratum, immediately beneath the action of the plough; but as a defect of moisture is equally injurious to agriculture, we shall, under this head, give a view of the distemperature of soils in general, with respect to moisture, and suggest what appears to us the most probable means of correction.

By the soil, we understand that stratum, which forming the upper covering of the land, affords support and nourishment to the various vegetables, and is stirred and exposed to the sun and air by the operations of agriculture. The thickness of this stratum, or depth of the soil, is very various; but in general it either already does, or by proper management may be made to extend to the depth of nine inches.

Soils vary greatly in quality, and are seldom composed of any single substance: but with respect to drainage, they may be all arranged into two classes, viz. the imperious, commonly called heavy or strong soils; and the porous, termed light or weak soils. Of the former kind are clay, or the substances combined with it, as clayey loams. Clayey gravels, &c. black peat earth also, before cultivation, is of this kind. Of the latter are sandy, gravelly, or other light loams, peat earth before cultivation, stone brush lands, &c.

The subsoil is the stratum which lies immediately beneath the former, and may be supposed to extend from nine inches, or the distance to which the operations of agriculture extend, to about 24 feet, or the depth to which drains are usually sunk, when intended to be covered and passed over with the plough. The limits of this however, like the former, are very variable; since, in many cases, uniformity in structure prevails to a great depth, while in others the soil lies immediately over rock, and may be said to possess no subsoil at all.

The influence of the weather, the agency of manures, and the residence of the various plants and animals that inhabit the soil, are confined to the upper stratum. The subsoil therefore chiefly demands attention, by its effects in regulating the supply of moisture. If excessively porous and dry, the soil above it is liable to be parched, and becomes unfit for the existence of plants. If porous and wet, the health of the plants above it is injured, or they give place to the ranker aquatics. If the subsoil be impervious, similar consequences take place, according to the weather; but if the subsoil be open to a sufficient depth, the water which filters through the soil, or which rises from the bottom, will be there carried off without injury to vegetation; while, on the other hand, a reservoir of moisture will be within reach of the roots, in the event of long continued droughts acting upon a light soil, and depriving the vegetables of their usual supply.

When there is land which nature has not already provided with this necessary stratum, it is the business of man to supply it. The substrata must be opened or closed as the case requires, until the water remain at a due distance from the vegetable mould. The distance depends on the quality of the subsoil and bottom; for loams will hold the water much higher than sand, and that again higher than gravel, owing to the greater capillary attraction of the smaller pores. The supply which is furnished or abstracted by the bottom, depends partly on its position, and partly on the specific composition of the strata.

The bottom or base of land is under the subsoil,comprehending every thing below the common operations of culture and drainage. It is the seat of springs, form-
Draining.

Draining. ed by waters derived from higher grounds; and of
swallows, which absorb or convey them off to lower.
These have, in many cases, an important effect on the
superincumbent soil, and their drainage is frequently
necessary for improving the land; but it requires a par-
ticular mode of management, which shall be described
under a succeeding head.

Like the soil and subsoil, we may also class the va-
rious kinds of bottom into the porous and impervious;
this being the most important distinction in the eye of
the drainer. But it may not be improper to be some-
what more particular in distinguishing the more re-
markable varieties of the strata of the earth, which will
give us a better idea of the qualities of the various soils
and subsoils, it being from the decomposition of the
former that these last are formed.
The crystallized mountain rocks, such as granite, &c.
seldom occur in situations fit for the labours of the agri-
culturist; it may be only observed, that having no fis-
sures, they are impervious to water. They decompose
into a sharp sand, which is one of the readiest conduc-
tors of water we have; and when covered by a clayey
or loamy soil, and well drained, form valuable lands,
producing great crops of potatoes and barley. The
chief granitic soils are in Cornwall, part of Leicester,
and Cumberland, in England; in Galloway, Aberdeen,
Ross, and much of the Highlands of Scotland; in Do-
negal, Galway, Wicklow, and Down, in Ireland. By
far the greater part are moors covered by fibrous moss.

The various kinds of slate rock are composed chiefly
of clay; and are therefore impermeable to water, ex-
cept in their cracks and fissures, which, near the sur-
fase of the earth, are numerous. The strata or plates
stand usually on edge, so that the water easily finds
its way down into them, and, splitting the rock by its hy-
drostatic pressure, works by degrees the surface into a
clayey loam. Under this the water sinks until directed
to the surface by closer strata; and then forms springs,
or watery land, according as it is in greater or less quantity. The ridges of the slate rocks running
parallel for great distances, form narrow hollows, which
are sometimes lakes, sometimes fibrous mosses, and can
only be drained with effect by cross-cutting the strata.
The ridges, on the other hand, are usually dry and fer-
tile. This kind of rock occupies a great extent of these
kingdoms, being found in Cornwall and Devon, most
of Wales, Lancaster, Cumberland, and Westmoreland.
The Highlands of Scotland, all the south and south-
east of Ireland, and in a band which runs from the
shore of Berwick across the channel to the banks of the
Shannon; as also in Derry, Donegal, and part of Mayo.
There are, however, many varieties, the best and hard-
est slate being nearly impervious to water, and keeping
the lands above them dry and sharp. The softer again,
or shales, imbibe water in considerable quantity, and,
parting with it slowly, keep the land above them con-
stantly moist and cold.

The sandstone rocks of every kind are more or less
porous, and transmit the water through their substance
like a filter. They are found in great abundance in
various parts of the kingdom. Often occupying the ri-
sing grounds, and usually of a reddish cast, the soil
produced from them is dry, and, though meagre, not
always unfertile. But the water passing through them
frequently acquires a mineral impregnation from iron
pyrites, which enables them to preserve vegetable mat-
ter from decay. From this cause we may account for
the numerous bogs or mosses which disfigure the base,
and banks of the sandstone hills, where water is fre-
quently oozing, and the bottoms of the deep sand dis-
tricts, from which it has not a ready passage. The
most effectual cure for it is draining to remove the
cause; and calcareous earth to free the water of its un-
sepctic property, by neutralizing the contained acids.

The greenstone, and green conglomerate or porphy-
ritic rocks, produce by their decomposition soils ex-
ceedingly fertile. The finer paste becomes a loam;
the larger pebbles form an open substratum: the rock
itself is generally close and retentive, though capable
of imbibing a considerable proportion into its substance.
The calcareous rocks are very various in texture.
The softer and granulous kinds, as the chalk in the
south and east of England. The oolite of Bath, the
cotesvold, &c. is of a porous and absorbent nature, and
imbibes the rain into its substance as fast as it falls.
The water descends, as in a filter, still more readily
than in sandstone rocks, until it come to an impervious
stratum, by which it is conducted into the sea, or thrown
out on the surface in the form of springs. The chalk
is only found to the eastward of a line from Dorchester
to Sunderland.
The harder kinds of chalk and limestone, though
closer in their texture in the individual specimen, are usu-
ally, in the great scale, divided by numerous chasms and
fissures, some of them opening into enormous caverns,
of which those in Derby, and in many parts of Ire-
land, are very striking instances. This kind of rock,
where uncovered by other soil, is consequently as free
a conductor of water as we know; even large subter-
naneous rivers sometimes pass through it. The most
striking example in these kingdoms is perhaps that of
Lough Mask, in the west of Ireland, where the waters
of a basin, of 250 square miles, pass for two miles un-
der ground into Lough Corrib. Many such basins are
alternately dry land and fresh water lake, according as
the supply is less or greater than can be conveyed
through the apophy, which forms their outlet. The
Cirknitz Sea in Austria is of this kind: See Cirnitz.
Such lakes are named Furloughs, i.e. Llandikes, in
Ireland, and are very common in Connaught. There
Furlough More, near Galway, covers an extent during
winter of several thousand acres.

Another sort of limestone is the magnesian, or water
Magnesian lime, occurring at shallow depths, and bedded in clay.
It is particularly remarkable for making lime, which
will set and harden under water; so that when applied
to land, it has just the opposite effect of common lime,
as far as drainage is concerned, binding and consolidat-
ing the soil, instead of opening it.
The limestone strata occupy a great extent of these
kingdoms, particularly in England and Ireland. One
great field runs from Berwick to Lancashire and Derby-
shire. The chalk also occupies most of the south and
east of England; and, in Ireland, the greater part of
Leinster and Connaght is a limestone country. There
are also many smaller tracts. There is but little lime-
stone in the north of Scotland, though it abounds in
the middle or lowland tracts, forming usually the ba-
son of the coal strata; as is likewise the case along the
Severn. The magnesian lime begins at Sunderland,
running southwards through the middle of England,
and turning off towards the Bristol Channel.
The coal strata are very various. The coal itself is
poresous. The chalk shale or till impervious, being
chiefly clay, and well adapted to cure the defects of the
deep sandy soils. The coal sandstones are usually some-
what argillaceous, and consequently not infertile. The
greatest tracts of coal country are from Bristol to Mer-
DRAINING.

Basalt. — Basalt, though an argillaceous rock, imbibes water into its substance, and parts with it slowly. It decomposes chiefly into an ochre earth, which is loose and porous on the hills; but in the deep bottoms, forms a strong loam upon clay. Antrim in Ireland, the Ochil and Campsie Hills, and some of the western isles, are the chief basaltic countries. The castle rock of Edinburgh, and neighbouring hills, may be also noticed. The basalt hills are noted for abounding in springs, which descend through their upright fissures, and are thrown out by the clay at their bottom.

Of the alluvial strata. Clay is an important member, and forms the chief material by which other strata are rendered impervious to water. When exposed, however, to continued drought, it shrinks, and cracks sometimes to great depths, thereby admitting water afterwards to penetrate it with comparative ease. Clay, therefore, is of itself not so thoroughly impervious, as when duly mixed with sand, gravel, or loam, which prevent it from shrinking to so great an extent.

Gravel. — Gravel of every description, from its open nature, is the most effectual of all conductors of water, at least when free from the admixture of earthy matter; for in this state it seems to aid the retentive nature of the loam, a mixture of it being frequently preferred for puddling hydraulic works. Where an open gravel is covered with strata of clay or earth, it is one of the most common causes of springs and watery land, the cure of which shall be treated of hereafter.

Sand. — Sand being formed of smaller particles than gravel, differs from it only by the slowness with which the water passes through, and the greater lightness which the capillary attraction makes it rise. In other respects, its properties are similar to those of the sandstone rocks already described.

Loam. — Loam varies according to the substances with which it is combined; but in general may be considered as retentive of moisture, at least after it is once thoroughly saturated and puddled, to use the technical phrase of drainers.

Moss-peat, or Bog, is of two kinds. The flow moss or red bog of Ireland, is a fibrous mass, composed of decayed vegetables of the moss kind; it retains water like a sponge, by capillary attraction, and after drainage, shrinks and compresses considerably. The other kind is that called black bog, in which the vegetable fibre of the mosses has undergone a certain degree of decomposition. This substance, though light, is totally impervious to water, and is frequently used in hydraulic operations for puddling, where good loamy earth or the like is not to be had. But after peat-peat moss has been broken up and pulverised by cultivation, it permits the water freely to percolate, insomuch that the upper parts of the ridges, especially when they are much raised, are apt to have the crops fail on them during the slight droughts of summer. Dried peat is quite impervious to water.

Having thus described the varieties of strata, and soils produced from them, we shall proceed to consider the effects of their various arrangement.

CLASS I. Impervious Soils. — Clay, or heavy Loam.

Case 1st. With Impervious Subsoil and Bottom.

Example. Deep strong clays, &c.—In this case, the rain water, after saturating the surface, being precluded from penetrating farther, can only get away by the slow process of evaporation. The soil is therefore continually moist and drenched during winter. Cattle passing over it poach the surface, and fill it with numerous cups or holes, from which the water cannot escape even though the surface have a considerable fall. The spring shoot of grass is late; the produce in wet summers is rank and coarse. On the other hand, in dry summers, the moisture is rapidly diminished; and as no supply can arise from the subsoil or bottom, the surface dries and hardens, cracking into gaps, which allow free admission to the sun and air, so as to scorch up almost every plant that is sown upon it.

In tillage, it is heavy and difficult to work, is cropped with uncertainty, and the semifluid clay, while the crop is young, is liable to close upon the roots of the plants, and suffocate them by cutting off the supply of air. The best account of this case, and means to be used for its cure, are those given by Dr Anderson; we shall give it in his own words. "These soils are usually in themselves naturally fertile when drained. It were to be wished that some less expensive mode of doing so were discovered than that practised in Essex, where they made covered drains of 2½ feet deep, running diagonally through the field at the distance of twenty feet from each other, or in every furrow. The wetness of this kind of land is not occasioned by springs, but originates entirely in the proper waters of the site, or what immediately falls upon it from the clouds. In copious rains, a part of the water finds its way along the surface into the furrows, if such have been made, and by which it will be carried off the field; but a considerable portion also sinks down into the porous soil on the tow, until it reach the solid bed of clay below, which never having been stirred or opened effectually, resists the passage of the water, so that it can penetrate downwards no farther. In consequence of this, it must force its way laterally towards the furrows through the upper mould; or if no furrows are provided to carry it off, it must gorge up the soil, and remain as in a basin, in which the superficial soil is mixed with the water in a thin paste, which remains of a soft consistency during wet weather, and in that state must be extremely injurious to the vegetation of plants.

When the dry weather returns, the sun and air will evaporate it, when the soaked paste, now deprived of its moisture, assumes a hard irony consistence, equally unfit for the sustenance of plants as in its moistened state. Such being the cause of this disease, the consequences may be easily removed. The opening of low drains running diagonally across the slope at a small distance from each other, if they can be kept open, will answer the same purpose nearly that the drawing of open water furrows would have done, and will doubtless mitigate the evil in proportion to their nearness to each other; but they must be very close together indeed if they remove it entirely; for still the soil must be drenched in the same manner as before, by the water forcing its way through it until it reaches the drain.

Now, as the rain water will sink perpendicularly through the soil until it meets with the solid clay before it attempts to seek a lateral direction, it must follow, that the lower part of the mould, or that nearest the clay, will be more drenched with water than those parts of it which lie at a greater distance above the clay. Of course, the deeper the soil the less will the surface mould be liable to be drenched with hurtful moisture; hence it follows, that if the soil shall be deepened to
such a degree as that the water, even during the greatest rains, shall not be forced to rise so high as to chill the roots of the plants which grow upon it, the remedy wished for will be effected.

It will be a matter of such great difficulty as at first sight it might appear; for as the soil sinks slowly downward through such a soil, that portion of rain which falls first continuing to sink regularly, if the soil be mellow, without stopping, goes gradually downward, making way for that which follows without being regained back upon it till it meets the bottom.

Hence, if we should suppose, for the sake of illustration, that the rain water sunk four inches downward in twenty-four hours, and that the rain continued without intermission for three days together, the water would have penetrated by that time to the depth of twelve inches, had it met with no interruption before the rain abated; but if the soil were not more than four inches deep, the water would have reached the bottom in twenty-four hours, after which it could go no farther, but the rain continuing to pour on more, the soil towards the bottom, by acquiring fresh additions of water every moment, is there soon reduced to the state of a semifluid paste; and as the water must rise higher and higher while the rain continues, more of the soil must be drenched by it until the whole becomes like a soft pap that is incapable of supporting the smallest animal.

Or, if the open furrows or under drains be near at hand, a part of the water will at last fall into these, and be carried off the field, after having wasted the surface mould in its passage, so as to carry off with it all the soluble parts of the manures it has met in its course.

But if the penetrable mould had extended to a greater depth, (say sixteen or twenty inches,) the water would not stop even when the rain abated, but continue to sink farther, till at last it would be all imbibed by the earth, without having reduced any part of it to the state of a pap, and even without the aid of any drain whatever. Thus would the mould, having never been reduced to the state of a paste, continue friable even when dry weather approached; and as the roots of plants growing on the soil would thus be invited to stretch to a greater depth, they would there find moisture sufficient to sustain them at a time, when, if they had been forced to spread abroad near the surface, for want of depth of soil, they must have perished for lack of moisture.

In this way the soil is rendered dry in moist weather, and moist in dry weather, to a degree that could not otherwise have been experienced; and as it has been already said, the water in its progress dissolves and carries with it a portion of the vegetable manures. This portion of manure, by the process above described, is all left in the soil, and of course tends to meliorate it instead of being carried off from it either by water furrows or the drains, which become indispensably necessary when the soil is thin, and which unavoidably reduces it to that poor hungry state, so frequently experienced under circumstances of the sort here described.

There are found in many counties of Great Britain and Ireland, immense tracts of poor, hungry, clayey soils, that are all reducible to the class of which we now treat. They have been denominated hungry, from the sudden disappearance of the effects of manures that have been need upon them; they are also called hide-bound, because of the hard stiffness, and miserable appearance of the surface. Few soils are in their present state more unproductive than these. Yet there are none, perhaps, which, under a judicious management, could be rendered more productive than many of them. It often happens that, over the whole surface of such soils, a thin crop of weakly rushes are produced while it is allowed to remain in grass, and fog or moss, which establishes itself there during the winter months, and is almost the only vegetable production, that gives a sickly verdure to the surface.

Upon examination, it will be found that, in all cases of this sort, the unloosened clay rises very near the surface; in consequence of which, the superficial mould which has been stirred by the plough, to a small depth only, being thinly spread over it, is subject to be drenched through its whole depth by every violent rain, the manures completely washed out, and the whole reduced to a pap over paste, that becomes hard like iron when the summer heat dissipates the moisture. Under these circumstances, whatever manures or cultivation are bestowed on it, are in a great measure thrown away, as they are seen to produce but very little effect, and these soils are therefore in a great measure abandoned as hopeless.

Many soils of this description, however, if opened to a greater depth, may be gradually brought into a state of greater productiveness. Indeed many of the most productive districts in this kingdom consist precisely of soils that were originally of this kind. When such soils are thus opened up, they are, for the reasons above assigned, more effectually drained than they could be by any other process. The manures that are, after this is done, worked into the soil, are never carried off from it, but gradually tend to ameliorate, and thus to render more tender and friable the bottom soil, so as in time to become deep, sound, and wholesome land, which is neither strongly affected by the varieties of drought nor of rain.

These effects, however, are not to be expected to be felt at first to their full extent. Some clays are so cohesive, that mere digging alone will not render them as permeable by water as could be wished. Before they can become sufficiently friable for that purpose to the highest degree, manures must have had time to operate upon them. For this reason, although the effect of deep digging and copious manuring will be at once sensibly felt, yet the melioration that will result from this process, will be going forward for many years to come; and by degrees will be coming nearer and nearer to that degree of productiveness for which the old lands of that description are so very remarkable.”

The means of deepening the soil require the consideration of various circumstances. Much will depend on the peculiar nature of the soil, of which there are many kinds belonging to this general class; and some will be more immediately benefited than others. In general, the surface mould, having been mellowed by frequent cultivation, should, by all means, be preserved at top, for the land in stiff clays where manure is not abundant, might be long in recovering the effects of trenching it down. It will be more advisable, after having turned over a large and deep furrow of the surface, to have men follow in the same furrow with strong and narrow spades to stir the ground without turning it to the top; or to follow the first plough by the minter, which is a plough without mould boards, calculated to stir the ground below without turning it to the top. This kind of trenching should be repeated when the soil is perceived to get bound below; and though it is by no means necessary to stir it up as often as the plough goes, yet it would be highly advisable to do so for strong soils during the autumn, that the land may be well prepared against the rains and frost of winter.
As to the modes of correcting these soils, it may be observed, that the friability and dryness is greatly promoted by liberal doses of lime, when it can be procured. Calcareous sand, which abounds on many of the shores of these kingdoms, is also a most valuable corrective for them; as, indeed, would be sand of any kind, and even dry peat mould or turf dust. Where no foreign substance is accessible, pairing and burning is still an excellent remedy, and should be resorted to without dread; though in many other soils it might be attended with injurious consequences. The clay, by this means, being baked, becomes a dry powder, permeable to water, which corrects the tenacity of the soil, while the rushes and other aquatic weeds are not only destroyed, but add a proportion of carbonaceous principle.

Though the above processes will, in all cases, operate a great improvement, yet it cannot be denied, that hollow draining may, at times, prove useful. The chief cause is the improper direction of the ridges; for if they run immediately down the slope and the top be flat, it is obvious, that whatever water falls upon the ridge will tend, after sinking through the mould, to pass forward on the clay in a direction down the slope, a course parallel to the furrow without falling into it. The consequence is, that the soil, especially in considerable declivities, may be as much drenched as if these furrows had not been made. To intercept that water, hollow drains are required, passing across the declivity; and care should be taken in constructing them, that the water may always have free admittance, while at the same time the materials may not be stirred, and of course the drain choked up by the plough: the best preventative for which is, to have the under soil so well opened that the water may pass into the drain laterally below the reach of the plough; for though the same end may be obtained by filling up the drain with porous matter, as gravel or turf dust, peat mould dried, yet it is difficult while the soil is under culture to prevent these from "puddling" up, or if not carried to the surface, to prevent the clay from caking over them; besides, such substances are not abundant in the clay countries. If the furrows were to be laid in the same direction as these drains, they would doubtless produce nearly the same benefit, and in many cases might be even more effectual than the hollow drains, since they are always open for the reception of the water. In other cases, where it may be inconvenient to plough in that direction, and in flat lands of retentive soil, as in most of the central counties of England and in Flanders, the general mode of drying the land is to lay it up in high and broad ridges of twenty to forty feet wide, with the centre or crown three or four feet higher than the furrows. The successful practice of the Flemings shows how effective this method is when well executed; for by attentively keeping the furrows perfectly free from water, the land is kept in a dry sound state, so that all kinds of crops succeed well. The frequent passage of the plough at a regular depth, forms as it were a polished surface under the stirred soil, parallel to the upper surface of the ridge. Upon that surface the water passes laterally into the furrows on either side, soaking through the stirred upper stratum; and by these furrows it is carried off the field. This is the true way in which the ridges and furrows act in the drainage of land, but it is not often sufficiently attended to. In many instances the furrows are not properly directed, or deep enough, or the ridges are too flat, by which means the water stagnates in the hollows, or lodges in the soil. This bad management has brought the method itself into discredit; so that in many places they have been levelling their ridges at great expense, without considering that this may, on clay soils, be very imprudent; for when the ridges are well rounded, not too high, with the furrows kept open and free from stagnant water, by means of well-directed cross water furrows, or gaas, as they are termed in the Cause of Gowrie, no mode appears better or simpler for draining land of a very retentive soil.

And here it may be observed, that since the most effectual way of draining these soils is by keeping them in constant cultivation, and to open and stir the subsoil, nothing can be more absurd than the policy so common in England, of prohibiting grass lands from being broken up by the plough. In soils of this kind, which compose a very great proportion of the grass lands of the kingdom, it is, in some measure, dooming them to perpetual sterility. Such land produces next to nothing in grass, while, by judicious culture properly persevered in, it becomes the most productive of all tillage. The reader will, we doubt not, see from hence the necessity of falls upon clayey and wet bottoms, which have been so much described by some agricultural writers.

Peat bog or moss may be compared to the clays in its raw state, or before cultivation, and should be drained in the same manner. Before its texture is broken, it will hold water like a dish. The facility of forming an open subsoil in peat is, however, vastly greater than in the clays; all that is required being to dig it, keeping the heath down: but on the other hand, the peat, when once dried, becomes like a piece of cork, and if wished to be productive, must be broken down and preserved in a certain degree of moisture. This is to be done by broad ridges and shallow furrows: the elevation of the middle of the ridge should be about ten inches. The drainage, however, though shallow, must be perfectly free, so that constant scouring becomes necessary when they are left open. The plants will thus be kept always within reach of a supply of moisture in dry weather, without which the crops might be blighted, and the upper peat earth, by exposure to the weather, cultivation, and manures, will be gradually converted into the most fertile black mould. The benefit of clay and earth mixed with peat, may easily be perceived from the tenor of this Section.

Deep drainage of mazes for agriculture, is therefore not only useless, but would be pernicious if effectual.

Case 2d. The Soil and Base as before—The Subsoil open.

Example. Clay loam upon gravel, or sand and clay bottom—bog or moss trenched, and cultivated upon black bog bottom.—The observations made on the last case will sufficiently inform the reader of the value of this kind of land, when the soil is of sufficient depth, and the subsoil sufficiently open to free the soil from collected moisture. Where the ground lies with a long descent, the water may possibly collect in the subsoil, towards the lower part, and pressing upwards against the soil, may soak through and injure it, forming a spongy clay soil. Whenever this appears, a drain must be formed across the slope, with a moderate descent, just above the part affected, by cutting down into the retentive bottom a few inches, and forming a channel there to receive the water as it collects, and convey it off to the open drains. If the slope be long, a succes-
Draining.

Drainage of these drains may be necessary; but in making them it will be proper to wait until the effect of the first be perceived before the others be opened. The principal case in which such a succession is requisite, is when the subsoil is sand, or a stratum through which the water passes with difficulty. In such cases, it is also frequently advisable to form a puddle wall across the subsoil, on the lower side of the hollow drain, for the more effectual security of the lower part of the field.

When the ditches in flat countries stand full of water, and gorge up the open subsoil, injurious effects are produced by the water lodging at the roots of the plants. The obvious remedy is to clear and lower the outfall, as already described in Surface-draining: The rule is, that the subsoil should be enabled to run completely dry, which will be sufficiently effected, if the water be kept at least two feet under the surface.

If such a fall cannot be had naturally, artificial means of drainage must be resorted to; and in these cases it may sometimes be necessary to form a puddle wall along the bounds through the subsoil, to keep off the influx of foreign waters, by a kind of embankment under ground.

Case 3d. The Soil close as before. The Subsoil and Bottom open.

Example. Deep loam or clay upon gravel, sand, or open rock.—This, if the soil is not only tenacious but deep, is a still more valuable kind than the last; care being taken to deepen the furrows so far as to communicate with the open substratum. Deep strong limestone lands are of this kind, and are of well known fertility.

But if the soil be thin, though sufficiently tenacious, it is apt to be parched, and to have its produce scorched in dry seasons.

The remedy is to deepen the soil, which, if no other mode is accessible, may be effected by gathering into high ridges or drills, or narrow beds, with alleys between, increasing thereby its thickness, though apparently lessening its extent.

Watering or irrigation is also found to be of peculiar value in this kind of soil; the remedy required being indeed the reverse of draining; and in order to retain the water in the subsoil, it might be advisable to form an artificial adherent bottom, similar to the Norfolk "pan," described below; or to introduce puddle walls of earth, at dead levels across the slope, which obliging the waters to descend lower before they could escape, might prolong their stay in the neighbourhood of the vegetables.

Class II. Open Soils.

Case 4th. The Subsoil and Base also open.

Though the due correction of open soils require an operation which is the reverse of drainage, it will not be irrelevant to our present subject to point out the most advisable modes of effecting it. Where the materials of these soils, though sufficiently open to prevent any surcharge of water, have yet such a due proportion of tenacious matter as to preserve the water from passing too rapidly away from the roots of the vegetables, the land is of a highly valuable kind. If this be not the case, and the soil be so open as to permit the water to flow quickly away through the porous substrata, the land is in a great measure useless. A few plants are, however, fitted to this kind of soil; and by encouraging their growth and decay, there will at length be formed from their exuviae a vegetable soil, which will in a great measure cure the defects of the original, and approximate it to

Case 5th. An open Subsoil on a retentive Bottom.

Though this kind of soil in its natural state resembles the former, it is more capable of remedy. Trenches, as above mentioned, must be cut across the fall of the
Draining.

ground through the subsoil unto the retentive bottom, and filled with retentive materials, as loamy earth, &c.
The furrows and ridges should also lie in that direction; and it would be proper in great declivities, to cultivate the soil in beds or terraces, the surface of which might be laid level. This practice is adopted in various mountain countries.

In these two last cases, where the country is flat and low, so that when the water stands in the ditches, the subsoil is gorged up with moisture, a disease of a different kind is produced. Land of this kind is among the most worthless that we know. In wet seasons, the rank aquatics take possession, and the site, if left to nature, would be speedily covered by moss, though, in dry seasons, the crops are scorched to the root by the sun and air.

The remedy, as in Case 2d, is to lower the outfall, by running drains in the subsoil. Care must be taken to prevent the sand from running into and choking them, and to lay them so as to preserve the bottom from injury.

If the outfall cannot easily be lowered, the soil should be laid in high beds, by excavating one part of it, and making up the other; thus acquiring a portion of dry land at the expense of a part of the surface.

Case 6th. The Subsoil and Bottom impervious. Sand, Gravel, or Loam, upon Clay. Light Moss upon black Peat.

This case, although possessing the same soil or cultivated stratum as the two last, differs greatly from them in quality. In wet seasons, the crop is liable to be chided, by the water lodging at the roots, and in the vegetative stratum, until carried off by evaporation. Aquatic weeds rise fast, and the soil is unfit to bear the tread of cattle, especially during winter. In dry seasons, the soil is scorched by evaporation, and can derive no moisture from below, so that the crops are stunted and blighted.

The remedy is to open the subsoil by trenching and following, as recommended in Case 1st, to which this has a great resemblance. Or the soil may be laid up in beds or high ridges, running across the slope with a gentle declivity, that the surplus water may be carried off in the furrows, while the soil is so far deepened, as to retain a supply of moisture in its pores for a longer period. This is the method usually practised in Ireland and in Flanders. Or hollow drains may be formed in the subsoil, running also across the slope, as is practised in Essex. Soil drains will answer well enough in such cases. If the lower soil be of good quality though retentive, a portion of the upper porous soil may be turned down by trenching.

In moss not thoroughly reclaimed, if the beds or ridges be high, the water passes too quickly away, especially when the land is in corn. It is better, therefore, in that kind of soil, to preserve the ridges pretty broad and flat, as a perch wide, and 10 inches high, but at the same time to prevent surcharge, by particular attention to the water furrow; and in all cases it must be observed, that every variety of soil requires a corresponding variation in the mode of management.

Case 7th. Subsoil retentive bottom open. The lack tea of Ireland, a hard Clayey Stratum below the Soil, covering open Gravel.

This case, in its natural state, resembles the last, but it admits of a ready cure; for, if the clayey stratum be pierced, the water passes immediately off by the bottom. But it is difficult to provide against drought. No remedy seems so obvious, as that of laying up the soil in beds so as to deepen it, while each alley may have holes pierced through the clayey stratum, so as to secure an effectual drainage during wet seasons, but be readily stopped up in case of drought. Or what would perhaps be still better, to trench up a portion of the gravel, to form a new subsoil over the first, and thus bring the case to No. 2. or 5.

Of the different kinds of Hollow Drains.

Before we proceed to the next division of our subject, we shall give a description of the different kinds of subsoil drains which are at present in use in different parts of these kingdoms.

Though open drains are perhaps the most eligible, for conveying the superabundant rain water from the surface where it falls, or for conveying the waters collected from the soil into the stream or river, they are by no means so advisable in drawing water from the subsoil, especially in lands under tillage. The substratum where the water issues is generally loose, and might slip into the open drain; and the tread of cattle is at all times injurious. Where the drain is intended to collect the water at its sides from the stratum in which it is formed, a certain depth of open materials is required for filling it, which is generally procured, by collecting the small stones in the field. These are termed "rumbling rivers" in some parts of Scotland. In Ireland, they are usually known by the name of French drains.

But where intended as an aqueduct or channel for water, collected from springs or other sources, it is advisable to form the drain hollow, by constructing a pipe or open channel along the bottom, and an absorbent stratum may be formed over it, so as to combine the advantages of both. In some cases, where drains are filled with straw or brushwood in firm earth, the drain at first is of the former, and, after these substances decay, becomes of the latter description.

In the eastern parts of England, where stone is scarce, and the wet bottoms were in most cases covered by coppices, it is likely that drains were first filled by putting three poles triangularly over each other in the bottom of the trench. Of late years brushwood has been much employed, and even straw trampled in or formed into ropes. Black thorns are found particularly durable; but wherever hard materials are easily procured, as pebbles or small stones, they are justly preferred for the formation of permanent drains.

The trench for the filled drain is formed by the plough or spade. In the former case two furrows are drawn, so as to leave a baulk between them of 15 inches wide; then with a strong double breasted plough made on purpose, that baulk is split, so as to leave a clean furrow 14 or 15 inches beneath the surface, or even by a second ploughing to the depth of 20 inches; it is then ready for the draining or land ditching spade, with which a narrow drain is dug of 15 inches deep. A scoop is also sometimes employed, for clearing out the loose materials in the bottom. These dimensions vary with the required depth and the plenty of materials.

When the drain is formed, it is next to be filled with such materials as the situation affords, the depth of which will of course be regulated by the supply of water. Fif-
DRAINING.

Hollow drains.

DRAINING. the largest and most open must be placed at bottom. Each faggot of brushwood, or bottle of straw of 140 to the lead, is sufficient for three perches of drain. Upon these materials a covering of some kind must be put, to prevent the earthy matter, with which the upper part of the trench is filled, from being washed down while yet loose into the porous part of the drain. Heth, straw, rushes, firn soil or clods, if such rise in making the trench, may be used for this purpose. Upon this covering, the loosenest and worst part of the excavated earth should be laid, and the finer mud reserved to occupy its place at the surface, and rounded up a little to allow for the shrinking. Plate CCXXXIII. Figs. 1, 2, show the form of this kind of drains. Fig. 1. is a drain filled with stones; Fig. 2. a clay drain filled with straw or brushwood.

Hollow or pipe drains are variously constructed. In districts where thin flat stones abound, and in cases where the subsoil is deep, and of a loose friable texture, square pipes of stone called goughs are formed at the bottom of the trench, by a wide flat stone as a bottom, a dry wall of splinters on the side, and a flat stone as a cover. The size of the pipe is about 6 inches in the clear. Similar drains are sometimes formed of bricks. Such drains are expensive, but effectual and durable. If the bottom be good, and declivity gentle, the sole or bottom stone may be omitted. See Fig. 3.

At other times, two flat stones are placed against the sides of the drain, meeting at bottom, and a third laid on them as a cover, so as to leave a hollow triangular channel for the water, liable to few accidents. See Fig. 4.

In Devonshire, where thin flat stones and rough pebbles are equally plentiful, it is common to form a channel, by coupling two flat stones triangulely, to meet at the top, and to fill in above with the pebbles. See Fig. 5.

Bricks are also formed for the purpose of hollow draining, and may in many cases be useful. These bricks are made of various shapes, but generally have a semicircular cavity for the water to flow in, and rest in stiff ground on the bottom, and in loose soils on each other, thereby forming a circular pipe or conduit. House tiles whelmed on pan tiles may also be used. These arch tiles may be made, when common bricks are at 1s. per thousand, at about 30s. per thousand without tax, and will lay a cavity of 6 inches by 5 of nearly 340 yards. Dried turf or peats have also been employed like bricks, in forming hollow drains in mossy soil. They might be cut by a grafting tool, somewhat in the shape of arched bricks; and even in the common shape, it is probable that they would last for a very long time in any kind of soil if previously well dried, while the facility of carriage would at the same time be of great advantage.

Drainage. Where a bottom of firm clay or stiff loam is situated beneath an open subsoil, very efficient drains may be made in the clay itself, by scooping out a groove of 5 or 6 inches square in the bottom of the trench, leaving a shoulder on each side. On these shoulders the upper sod is rested, with the grass side underneath; or sods are brought for the purpose from old grass lands. The excavated mould is then laid over the sod to fill up the trench. See Fig. 6. As the turf decays, a part of the cover falls down, and forms an arched roof to the pipe. Drains filled with straw, get into this shape by the decay of that substance. Another very simple kind of sod drain is formed, by means of a strong common plough, and may be found particularly useful on sheep pastures. A deep furrow is first drawn through the hollow parts where the water stagnates. A man follows with a spade, and piling off the loose soil from the lower side, so as to leave the sod or spawd about 3 inches thick, turns it back again into the furrow. By this means a triangular opening of 3 or 4 inches is formed, and will discharge a considerable quantity of water. An operation which, in case of need, may be easily repeated.

Hollow drains are also formed by billets of wood, set end on in the drain, and resting on either side alternately. The space left between them on the upper side is filled with brushwood, straw or rushes over that, and then the earth turned in. Aquatic weeds should be used, and laid when green. See Fig. 7.

Another method is to fix in a stick like a hoof, at the distance of every foot or so, and on these lay the brushwood longitudinally; or to lay some stout sticks across the shoulders of the drain, and cover this by spray, and the turf inverted. The greatest defect of these is, their being liable to be injured by the feet of cattle when ploughing.

When hollow drains are made in moss, it will be sufficient to cut down the fibrous turf to a proper depth, and then with the feather-edged peat-spade, or slave, to take out a groove in the bottom. This operation being performed in summer, the shoulders will dry, and become firm; and a part of the turf extracted being dried into peats, they may be placed over the groove, resting on the two shoulders, and the trench filled up with the broken stuff, which will be found to transmit the water freely. In the slitter countries, a slate may be laid in that way over the groove, and will be very durable. We have seen such drains running freely after thirty years, although the slope was considerable; a proof that fibrous peat moss, when kept from the sun and air, affords a good bottom for hollow drains.

In excavating such drains in moss, it is not necessary to dig open the whole length of the trench; for parts of the surface may be here and there left firm, and a pipe or sewer scooped out beneath them, to admit the water to pass along. These solid parts will be very useful as bridges, and soon becoming dry and tough, will, if gravelled over, admit even heavy carriages to pass on them. In this way, when the size of the drain makes it worthwhile, half of the cutting may be spared.

As peat, when once thoroughly dried, imbibes water again with great difficulty, and is so durable that as to be sometimes used in Holland for the foundations of houses, there is no doubt that broken peat would answer as well as stones for filling subsoil drains, and in many cases might even be preferable.

Various inventions have lately been proposed, for forming drains by machinery. Of these, the mole plough and draining wheel seem worthy of notice. The former consists of a bolt, or pin of iron, drawn horizontally at the depth of a foot or more. Beneath the surface, a thin coulter rises from the bolt or spade, and connects it with the beam, and is the only part which makes any mark on the surface. Even this disappears in a few days, leaving a bore of 34 inches in diameter, which is found to run well, and in cold retentive grass lands may be highly beneficial. The chief objection as to all other schemes of the kind, is the great retentive capacity required to draw it. A capstan and small anchor is sometimes employed for that purpose. The draining wheel has been already described. See Agriculture, Vol. 1. p. 329.
If the field has a considerable descent, care must be taken to have the drains nearly horizontal; for, if they have too quick a fall, they are apt to excavate and burst up. In such cases, as the drain only receives water from the upper side, it is advisable at times to puddle along the lower side, that the water may not, by running over through the subsoil, injure the lower part of the field.

When the hollow drain is carried through running sand, it is necessary to support the sides of the trench by boards and props, which are removed forward as the work proceeds. In making solid drains also, loose earth or sand is sometimes met with, in which cases the pipe must be lined with turf to prevent its choking, the loose earth being previously cut out to a sufficient width to admit of this.

The mouths of hollow drains being much frequented by cattle, should be formed with stone, or otherwise protected; and too many of them ought not to be run together, lest an obstruction in the main, cause an extensive mischief.

CHAP. III. Of Drying Spring Grounds by Draining the Strata.

Having now shown the principles by which the reclaiming of watery lands is effected, when the water lodges on the surface, or is injuriously stagnated in the soil, we proceed to the third division of our subject, in which we mean to consider those cases where the ground is hurt by the oozing of subterranean waters, or the flowing of springs, producing wet spotty land, bogs, and quagmires.

This subject is much more complicated than the other two: it constitutes one of the most beautiful, and perhaps the most important, applications of the doctrine of hydraulics; it is surprising, therefore, that it has been so little attended to by scientific men. Though many of them have written on the subject of springs, few have endeavoured to render their speculations so far useful, as to lay down a few principles for the benefit of the intelligent farmer, on a subject in which all are so much interested.

The first person in this country to whom we are indebted for a practical and intelligent treatise on the nature of boggy grounds, and the method of curing them, by relieving the subjacent waters, was Dr. James Anderson, in his Essays relating to Agriculture and Rural Affairs, printed in the year 1775. About the same time, Mr. Joseph Elkington had fallen upon the method of tapping subterraneous waters, by means of the auger, in the course of draining his farm in the county of Warwick. Mr. Elkington was, in consequence, much employed as a practical drainer; and his success was so great, that the Board of Agriculture, in the year 1795, proposed that a parliamentary reward should be given to him for his discovery. An account of his method was afterwards given by Mr. John Johnstone, and published by the Board, from which much useful practical information may be obtained.

Springs are formed, or have their origin in the different strata of the earth by the rain water which falls upon it, sinking into those which are of a porous nature, and descending until they meet with a bed of clay, close gravel, or impervious rock; upon this it either passes along the declivity of the bed, soaking through the porous matter which lies over it, or it collects, as in a reservoir, until it is emitted at some part of the surface of the ground, forming all the different phenomena of springs. Hence we see, that in countries of deep sand or gravel, without beds of clay to force the water to the surface, abundant springs are not to be met with; and again, the deep clay countries are equally destitute of spring water until we descend through the clay into a bed of sand or other open stratum, the only situation in which the water can flow in abundance, and in which it is only made to pass horizontally by a bed of clay, or other impervious matter opposing its further progress downwards. If this bed or floor of clay, instead of coming to the surface, should have its lower edge terminate in the sea, a deep lake, or the bank of a river, the water which has descended to it will find its way into these natural receptacles, without ever making its appearance on the surface of the land; and there can be very little doubt but that much of the water which falls on the dry land escapes in this way without being perceived.

But if, from the unevenness of the surface of the land, and the abruptness of the strata, the lower edge of the impervious bed should any where reach the surface, as is frequently the case on the sides of hills, in deep dingles, &c. the water, which was collected in the porous strata above, will there make its escape; and as a considerable time must be required for its passage through the obstructed interior channels, the intervals of drought will not always be sufficient to admit of the whole being delivered before a new supply comes again from above. In this manner, a frequent, or even continual, oozing of water may be formed; and if it be not confined to a narrow channel, but allowed to spread over the grounds below, plots of watery land will be formed, and in time covered with aquatic vegetables, which, by their decay, are converted into peat or bog.

This case has been denominated descending waters by some writers, and forms the first class of boggy ground arising from springs. Plate CCXXXIII. Fig. 8, represents a plan and section of a case of this kind. AB is a bed of deep clay, extending from the brook at A, back under the hill DE. CD is a bed of sand or open stratum covering the clay, and is covered in its turn by the different porous strata forming the hill or bank CDE. These strata imbibing the rain-water which falls on the hill, allow them to descend until they reach the line CD, where their further progress in that way is stopped by the bed of clay BA. They accordingly accumulate in the sand, until the increasing pressure forces them through the different pores and fissures in the horizontal direction DC, and they issue at Cc, the foot of the porous bank, in springs of pure water, which run forward in rills to the brook Ao, which, if an open channel is preserved for them, are not likely to do much injury to the farmer.

But it usually happens, that the edges of the porous strata EC, have been worn and broken down by the vicissitudes of weather or other causes, and their rubbish or detritus carried forward over the low ground CA, cc, forms a porous soil over the clay bottom. In this case, the water which issues at the springs Cc, instead of passing off in rills, soaks into the porous soil, and keeps it constantly drenched with wet, so as often to injure a great extent of ground below, especially if the subsoil be shallow or retentive, as is commonly the case with lands not ameliorated by cultivation. Many millions of acres in the upland countries of these kingdoms are still in this condition, their surface covered with peat moss or bog, which nevertheless might be drained at an expence inconceivably small.
The remedy is obvious and simple. Proceed to the upper line of wet ground, and examine if the springs there are flowing as abundantly as those below; if that be the case, you may conclude that the water is delivered by the "cropping out" of a bed of sand, gravel, or open rock, over a bed of clay or other close substance, at that place, and the lower patches are merely the overflow from thence; ascend to the level of a yard or so higher than the springs: you must then be in the open stratum.

Cut down a ditch, until you penetrate some way, (a foot or more,) into the solid bed or close substance; you will then perceive the water oozing from the soil above, and dropping into the trench which you have cut in the clay: continue the trench horizontally along the line of springs, making sure at all times to cross-cut the watery stratum: in this trench put a proper hollow drain or conduit, fit to convey the quantity of water, or if it be but short, you may fill it with stone; and it will not be unadvisable to build up a water-tight partition of the clay on the lower side, so as to prevent the water from overflowing the drain, and passing again into the soil below in wet seasons. Fill up the rest of the drain with stones or the porous soil, in the way already described. All the space must be put on the lower side.

From this catch-water drain there must be, in convenient places, tail drains to convey the water to the nearest brook. It is more advisable to make the fences of the fields answer this purpose; for as the slope is sometimes considerable, these drains must generally be left open, lest they should cut their beds, and burst.

But a drain may be made at the level of the catch-water, and brought out under cover until it reach the surface, along which it may then be conveyed as an open rill.

In carrying the catch-water drain along the line of springs, it may sometimes happen that springs appear above the level at which we are proceeding, in consequence either of a dislocation of the stratum, or by being in a small bay or glen, and that it would require very deep cutting to bring it into these springs on the same level. In such cases the drain may be carried across the bay, care being taken, if the soil through which it proceeds be porous, to prevent the water from escaping; for it is evident, that if we form a clear channel among the lower parts of the sand, that the water will be so far drawn off thereby as to drain all springs on a higher level that have their origin in the same stratum. But in case the bay or glen thus left out should become watery in moist seasons, a little horse-shoe drain should be run round it, upon the same principles, and delivering its waters into the general catch-water at each end. This little catch-water having a greater slope, might carry stuff into and choke the greater one, unless proper precautions be taken.

But the same measure will by no means answer in the event of our finding the sand stratum take a dip, or run out below the level of our catch-water. In such a case, it becomes necessary either to make an entirely separate catch-water round this lower tail, or to cut down across the porous bed into the solid floor, and bring up a regular puddle wall from thence to the surface.

When the upper waters are thus cut off, the grounds beneath deprived of the sources that supplied them with perpetual moisture, may be expected in a short time to become dry, as the water which they retain gradually passes away. In order to accelerate this operation, and at the same time to have an opportunity of cutting off any lower springs that may exist in the wet surface, it may be proper to draw other drains, parallel to and of the same description with the former, at some distance down the slope. And it must be evident, that where there are various strata of sand and clay alternating, each of them will produce, beneath it, similar effects, which must require to be obviated by the same mode of proceeding.

The declivity of the surface is frequently so little different from that of the strata, that a bed of sand, as DC, instead of ending abruptly, as in Fig. 8, may continue along the surface for a considerable extent before the inferior layer of clay crop out, or become distinguishable.

Thus, in Fig. 9, the bed of sandstone DC, which Fig. 9. comes from under the hill EDF, continues to run along the surface from F to C, and is not entirely lost until we find the clay at C rising or cropping out from beneath. The upper part of this stratum decomposed by the weather, forms a sandy soil throughout the space from F to C, which having an open stratum, will, in general, be friable and dry, and if covered with a rich loam, will form a peculiarly valuable soil, well fitted for the turnip husbandry. If the quality of water which sinks into this porous bed be tolerably uniform, and the bed of sand be deep, the moisture will never rise so high as to injure vegetation. But if it be so circumstanced that a considerable quantity of upper waters, during great rains, sink into and are absorbed by this bed of sand, then the difficulty of transmitting such a quantity will make the water rise higher in the soil, and though the upper parts, as at F, may be dry, the lower, towards C, will be gorged to the surface, and the water will ooze out of it in peering springs, forming a field there of damp sand, the most worthless that the farmer can possess.

In this case, the first subject of enquiry is, whether there be not at the tail of the sand an obstruction, such as the clay C, rising up and forming a kind of dam against the water lodged in the sand. If that be the case, let a drain be cut through the clay, and at the level of the bottom of the sand, or somewhat lower, as CB. Then along the tail of the sand form a drain CE, which giving free emission to the waters within, will allow them to sink to that level, so as not to be injurious. If this operation has not a sufficient effect, it must be owing to the pores of the sand bed not being sufficiently open to admit of the water passing with freedom. In that case, carry up the bleeding drain into the sand, giving it branches on either side, which, by enlarging the surface of emission, may make amends for the retentiveness of the soil.

But in such cases, it is often worthy of enquiry, whether it might not be better to cut off this load of upperwaters before they descend into and injure the field in question; and that, either by leading away the sources from which they are derived, or by forming a dam against them at the upper margin of the field so as to bring them to the surface, and in that way not only protect the lower field, but obtain a useful supply of water for other purposes. In this way (Fig. 9.) a ditch or trench is cut at G, being the uppermost part that appears damp in the wettest seasons, and is carried down through the whole depth of the sandy stratum into the solid clay below. If it is then formed into a drain in the usual way, the water from above will be com-
Draining.

Draining.

Drying of spring grounds.

completely intercepted; but, independent of the first cost, the expense of keeping such a drain in order would be very great, the depth in such a case being considerable. Another expedient that occurs, is to fill up the trench, thus formed, with a regular puddle wall, or partition of clay and gravel, loamy earth, or black raw pent moss, wrought with water to the surface, behind which the water, if properly intercepted, must rise as behind a dam; and when we have it within two or three feet of the surface, the drain may be forrowed in the usual way, so that the superfluous water is led to a proper outlet, and which in case of need is easily accessible; by this means the upper part of the field is so far drained, as to have an outlet two feet lower than before, and we acquire such a command of the water, that it may easily be kept up to its original level, while the lower parts, which were formerly of the nature of quicksand, and covered by morass, are entirely protected from upper waters, and have their proper waters drawn off by the bleeding drain c, as before. Where the overlying strata EF are of an impervious nature, the wetness of the sand may be, in a great measure, owing to the surface waters of a great extent of sloping ground descending over the surface EF, and being absorbed at F into the sand. In this case it is evident that these surface waters may be intercepted by a shallow drain, on the retentive soil above F, and led away to an outlet before they descend into the sand. It is equally evident, that we must be careful not to cut the sand in this drain, or, wherever that is unavoidable, that we line the trench, so as to prevent the water from sinking away; yet in this case especially if the uplands be in tillage, the drain will soon settle itself up, and be sufficiently retentive even over the sand.

The next case for consideration is, that where the stratum of sand, or other porous matter which conveys the water, dipping faster than the surface of the ground, does not crop out, or appear at the lower edge, but runs forward under the surface, and is covered by a layer of clay or other retentive substance.

Plate ccxxiii. Fig. 10. exhibits a case of this kind, where the watery stratum DC descending from the porous upland DKL, having no outlet at the point e, is covered by the retentive clay BEFG, extending back to H. In this situation, the water finding no outlet, will accumulate in the stratum DC, and be pent up as in a vessel, until it rise to the upper edge of the covering, and flow over as at H. Now, this level of the outlet being considerably higher than the surface of the covering of clay below, it is plain that there must be a strong pressure upwards against the bottom of the clay, in such a way, that, if a pipe was put down at G or E, to reach the sand, the water ought to rise in it to the level of the fountain H. If the bed of clay, as from C to F, be of sufficient depth and tenacity to resist this pressure, the soil on the surface will be no way incommoded; but if the covering be any where weak or thin, as from G to H, the head of water pressing against it will force some of the weaker places to give way, when it will burst out, and form a spring as at MM, and the water will immediately subside; and should this not be sufficient for the discharge of the whole in wet seasons, the water will again rise, so as to run also at other higher and higher openings, which after some dry weather will cease again, though the lower may still continue running. The upper level of the water will never subside so low as the spring MM, though it may remain very little above it, since at least some force will be required to press the water through the obstructions in the sand. From this cause, the ground from K to H, though of an absorbent nature, is frequently retained in a state of wetness, similar to that at CG, Fig. 9, on account of the moisture standing high in the subsoil, and, if left to nature, will be soon covered with moss. Again, where the texture of the clay covering is sufficiently strong to prevent springs from bursting out, yet the water will squeeze through all the pores and crannies, so as to saturate a small field of sprouting clay soil, producing only rashes, or other aquatic herbage, or brushwood from F to H. Where the depth of clay is so great as to prevent the oozing from being of much consequence, yet the water standing high in the subsoil, forms a field of cold, damp, clay land, as from M to F, and F to E, liable at the same time to be injured by the surface water from the springs above. In this situation, the cure is to form a drain in the neighbourhood of the lowest springs, and at such a level that the water which runs in it may be so much below them, as to leave the land dry. This ditch must be sunk down in various places, so as to tap the inferior watery stratum; upon doing which, the water lodged there will issue out in abundance, and flow along the drain; and having now found a lower outlet than the former springs by which it issued, these will quickly fall away and dry up; nay, if the stratum be of great extent, the same effect may extend to several boggy lands in the neighbourhood, and, to appearance altogether unconnected with the first. The height of the confined water being now diminished, the pressure upwards against the cover will cease, and this being the only cause of injury, a radical cure will be effected; but no hollow subsoil draining could have had this effect, although the land might be somewhat relieved thereby, in many instances, especially if the drains should any where touch the stratum of gravel or sand in which the water was contained; neither would any benefit be derived from a catchwater drain, made at H or K, in the last case; or even if we could sink down through the whole mass of sand, and bring up a puddle wall from the firm clay, would it be effectual, for such a dam exists, in fact, already in the covering of clay, BGH; and though we cut off most part of the supply thereby, the water in the bed of sand HC is not removed; the spring M which still delivers the little water that may insinuate itself, may be greatly weakened, or even cease to overflow, but the hydrostatic pressure against all the lower subsoil will still remain as before. We mention this the rather, that the inexperienced drainer may be on his guard, and not proceed to work until he is well assured of the nature of the case before him; for the mode of proceeding in one of these cases would be altogether useless in any of the others.

Having brought up the outfall, or tail drain BG, and formed the tap drain G G along the lower springs, our next operation is to open a communication with the watery stratum below, if that has not already been effected in digging the tap drain. Now, as a few passages will be sufficient to emit all the water, provided their area exceed that of all the springs, there can be no necessity for sinking all the tap drain to that depth. Small pits may be made at convenient distances, and, to prevent them from choking, they may be filled with stones, dried peat, or the like, through which the water will rise freely. But, in general, unless where the stratum to be pierced is very stony, and even in that case if it be deep, it is much easier, and less expensive, to make use of the boring auger, with which
holes are to be made at every few yards in the bottom, or on one side of the drain, down through the retentive covering, until the stratum below is tapped, and the water rises in the bore, and flows along the drain made in the upper clay. This instrument has been long employed in digging wells, and in mining for the purpose of searching for water, and drawing it off; but seems first to have been employed for the drainage of land by Mr Elington; though the principle upon which it is applied was first published, and the use of it suggested, by Dr Anderson. It is, without doubt, an instrument of great value to the farmer, both for this purpose, and for examining the various inferior strata of his lands, by which useful discoveries are often made. But its utility as a draining instrument is by no means so universal as at first it was proclaimed to be.

"The borer used in draining, is similar to that made use of in searching for coal, or other subterraneous minerals. The auger, shell, or whimble, as it is variously called, for excavating the earth and strata through which it passes, is from two and a half to three and a half inches in diameter. The hollow part, intended for the whimble used by carpenters, only the sides of the shell come closer to one another. The rods are made in separate pieces, of four feet each, which screw together to any length, one after another, as the depth of the hole requires. The size above the auger is about an inch square, unless at the joints, where, for the sake of strength, they are a quarter of an inch more. There is also a chisel and punch for screwing on, in going through hard gravel or metallic substances, to accelerate the passage of the auger, which could not otherwise perforate such hard bodies. The punch is often used when the auger is not applied to prick or open the sand or gravel, and give a more easy issue to the water. The chisel is an inch and a half or two inches broad at the point, and made very sharp, for cutting stone; and the punch an inch square, and sharpened also. There is a shifting handle of wood, that is fastened with two iron wedges, affixed to it for the purpose of turning round the rods in boring; and also two iron keys, for screwing and unscrewing the rods, and for assisting the handle when the soil is stiff, and more than two men required to turn it.

The manner of boring and this. In working it, two men, or rather three, are necessary; two stand above, on either side of the drain, who turn it round by means of the wooden handle, and when the auger is full they draw it out; and the man in the bottom of the trench clears out the earth, assists in pulling it out, and directing it into the hole; and who can also assist in turning with the iron handle or key, when the depth and length of the rods require it. The workmen should be cautious not to go deeper at a time than the length of the shell, otherwise it is difficult to pull it out. Two or four flat boards, with a hole in the side of one of them, and laid across the drain, are useful for directing the rods, and for the men to stand on."

In boring or forming pits for tap-drains, it is not necessary to put them down in the quagmire; for that can seldom be done with effect, the stuff closing upon them so speedily. It is better to have them in the firm ground, as near as possible, especially at the commencement. After the water has been tapped by these, the quaggy ground will subside, and get firm; enabling us to prolong the drain, if need be, and to sink new pits or bores, in case the stratum containing the water should be interrupted. The most convenient place, without doubt, is that where the stratum approaches nearest to the drain. The bore C, which is put down near the tail of the sand, is not more useful than the bore G at the same level; while a bore at g, which passes the tail of the sand, can be of no benefit whatever. In general, immediately over the watery bed there is a stratum of tight clay mixed with stones, of great firmness, under three or four feet of quaggy ground; this has often deceived the inexperienced drainer, by leading him to think he had arrived at a sound bottom. This is a good situation for laying the conduit or sough of the drain, if the level of the outlet admits of it; but it must be pierced by the borer, or pick and spade, without regarding the trivial springs that appear therein, until the reservoir be arrived at. By a careful examination of the adjoining ground, it is sometimes possible to say at what depth this may be found; but, in general, the rule is, to go down till the water rise immediately on withdrawing the auger. Mr Elington has bored thirty feet before the water flowed plentifully, but from this to fifty feet is more usual.

The improvement of this general scheme that often occurs in this kind of draining, and, at the same time, show how the same principles may be applied to other cases, and especially the digging of wells.

DC is a stratum of sand, resting on a bed of clay or solid rock, and extending under the hill L: it only basons or crops in the level valley from E to K, where it forms the bottom of a peat bog or moss, which has risen over it, on account of the valley having little declivity, so that water stands constantly in the sandy subsoil. BE is a bed of clay lying over the sand, and likewise running under the hill; beyond which it crops out at E. This bed of clay in the vale, from C to F, is but thin, so that there it forms a bottom of spouting clay soil, with springs and quagmires, owing to the pressure of the water in the sand bed below. The hill L is composed of gravel and sand; but, on the right side at F, this is overlapped by a thick cover of clay to the summit: on the left side also, at H, there is a cover of clay, which is much thinner, and does not extend to the summit: it abounds in springs, forming a bank of spouting clay soil with rushes. Each of these covers of clay unite with the bed BE at the foot of the hill, where a field of cold clay land is found on either side.

Now, the improvement of this general scheme is shown by the proprietor on the left side, who proposes to drain the moss KE by bleeding the sand; for this purpose, he leads up the main drain EC along the tail of the sand, where it meets the clay. He finds it necessary to sink it only by little and little, so that the sand may have time to drain and get firm, otherwise the sides run in upon him: and that he must clear the whole length of the drain to the outlet, before sinking any part lower than another; for after getting down an inch or two, the sand appears as fluid as water. In this operation he succeeds to a certain degree; and it is perceived, that the run of water from the valley, by the drain E, is greater than it had ever been before; and at some time, the quaggy bottom on the right of the hill has been somewhat benefited, and the springs at G give rather less water. The reason is obvious: a part of the supply is diverted, and the fountain-head lowered. Were he to persevere until he came to the bottom of the sand, the land at G would be drained, for it is on a higher level; but this proprietor has no interest in so doing.

He next proposes to find water at K, in the morass,
Draining.

Plate cccxxiii.

Draining.

PLATE cccxxxii.

For which he sinks readily in the sand to the level of the drain E. Below that is a quicksand, which can only be excavated by dredging under water. His next operation is to drain the springy bank below H, and, at the same time, to get water at a high level, he makes a tap drain H/; and bores in the bottom, until he cuts the open gravel of LHF, which furnishes a supply, and relieves his ground.

Suppose now the proprietor on the right wishing, in like manner, for a supply of water, makes a tap drain on his side, along the hill, as at F, but somewhat lower than the level of H, and bores into the under stratum; the water of the hill LHF will now flow away at F, and the drain H/ can be dry; but the land round H will be somewhat better drained than before. Suppose the proprietor at H still wanting a supply there, should bore down through the stratum of clay EB, and, into the sand DC; instead of raising any water by that means, the whole supply of HLF will now run down through the bores at H, into the sand DC, and pass away by the drain Ee; so that the ditch E/f will in its turn be dry. Nevertheless a well or pump at F will always find water in the tail of the basin HLF; and if the bore at H be below the level of the drain E, the supply may even be more permanent than before, since it communicates with the great bed DC.

Lastly, suppose that the wet bottom on the right hand is to be drained; for which purpose the tap drain Gg is laid out, and bores sunk into the sand DC. The water will now rise up from the sand, and relieve the quaggy clay above; the springs in the bottom will cease, and, what may appear still more remarkable, the main drain Ee beyond the hill will ebb dry, and the quicksand around will become firm and dry, as now as the level AGB of the tap drain. The well at K may now be sunk without difficulty; but no water will be found until we arrive at the clay, (above the level before mentioned,) and even then only by cutting a reservoir in the clay, to receive a part of the waters which trickle along its surface through the bottom of the sand. No overflowing well can now be made in that situation, even should there be strata containing water to a higher level below, which might be bored into, unless a close stearing or casing be carried up through the sand bed DC, to prevent its ebbing away by that channel through the drain G; but, before tapping at G, if we had inserted a bore at m, which is below the level of E, we would have had an overflowing well on the top of a hill; and again, if the stratum of clay at H were not yet cut through, we would have at the same time another overflowing spring at F, which would appear to be the hill from which the fountain at m was derived. We have seen instances of this kind in natural springs. It is worthy of remark, that the proprietor on the right side dried likewise the grounds on the left, in the act of draining his own; and he could not avoid doing so. Similar effects take place frequently in the drainage of mines; and when these are level free, they may be frequently applied to the purpose of draining the lands above, by boring down at H, or boring upwards from the mine. But where the mine is drained by artificial means, as pumps or the like, it becomes of the greatest consequence to cut off and remove all supplies of water that may enter from above.

Suppose, for example, that DC were a bed of coal, or other mineral, drained artificially at K, and that a shaft were to be sunk at H, it would be necessary to pass through the open stratum in the hill LHF; if this were a quicksand, abundant in water, it might be very difficult to be effected; and it would be necessary to introduce piece after piece of curb timber around the shaft, to prevent the sand from running. Even if we should succeed in getting down, the water would descend through these timbers abundantly, as to greatly damage the water on the engine at K, and might even drown the mine. The remedy, in that case, is to surround the leaky part of the shaft H with an inner casing of timber, and a puddle wall of clay, &c. behind it, and to unite this puddle wall with the beds of clay both above and below. The mine being then relieved of foreign water, will be restored to its original state, and will come again under the power of the engine. But suppose the bed EB not to be so completely retentive, but that water may penetrate through it when the lower beds are laid dry, especially if it be pressed by a great force, as the water accumulating in the hill LHF, then it may be still possible to relieve it from that pressure, by tapping; for example, at H or F, so as to lower the head of water in the reservoir, which will not then be able to penetrate through the bed EB, or, at least, not so abundantly, and the engine at K will be greatly relieved. Similar effects will also be produced; by having a catch-water dam, or puddle wall, to lead off the water, which would otherwise be absorbed on the upper side of K, towards the crop of the strata, as described in Figs. 8. and 9. A leaky stratum may be covered or lined with puddle, and secured in a similar way. The writer of this article has puddled the fissures of a leaking rock, and sunk shafts into it, although situated under the water of an extensive lake.

Suppose again, that the proprietor on the right hand at B intends to work his part of the bed of coal, and to drain with engines by the shafts G or m. But that the proprietor A, who will be equally, or more benefited, and whose engine at K will thereby become unnecessary, refuses to assist him. Then B, having no other resource, places a powerful engine at G or m, and sinks to the coal; but he takes the precaution, after driving his engine level along the coal as low as he can reach, to make up the lower side of it with a puddle wall of clay, &c. In like manner, he cuts out the coal along all the boundary of his property towards the basin, and replaces the excavation by water-tight materials, so that all the water which formerly flowed in upon him from the basin of the strata is now puddled off; and he finds the drainage of the remainder can be effected by much less power, than was necessary for his first engine at G. While the proprietor A, whose coal at first was laid level free, is now perhaps worse off than before, since he is deprived of the benefit of springs, that may have flowed at G, below the level of part of his coal. Should there be absorbent strata in that direction, and above his level, he will be benefited by the puddling. A case of this kind occurred some time ago near Edinburgh, and occasioned much litigation. The beds of coal, and other minerals, are frequently traversed by natural partitions of water-tight matter, which are of great benefit in the drainage of the mines. It is surprising how thin the partitions are, which resist great depths of water in this way; and which, when they are incautiously broken through, are productive of great difficulty, and even danger; so that it is advisable, in all dubious cases, to make constant use of the boring iron, to discover them, as the hole which is thereby made may be easily stopped up in case of need.

Puddling is also used in the digging of wells, to keep out salt or mineral springs, which may flow into the
DRAINING.

Before the stratum containing wholesome water is reached; and it is also used in mining for protection against a stratum, which emits hydrogen or inflammable air. A remarkable instance of the former is related in the Philosophical Transactions, vol. lxiv. where an account is given of sinking a well at Sheerness. When similar circumstances occur in boring for water, the remedy is to introduce a pipe of wood or metal into the bore, which admits the water only at the lower end. Nearly the same advantage is sometimes obtained by excavating the hole a little wider in such a stratum, and pressing in clay, which the water will keep from being displaced. If the water in the spring, which is formed at G, were confined by a surrounding wall, it might be made to rise to the level of the original outlet at E; and a pipe might be laid from thence to the top of the bank at m, so as to deliver water without sinking a shaft there, or boring for it; for in neither of these cases would it rise higher than the level of G, if previously tapped there. Or the same water, if abundant, may be applied to the working of machinery, when a fall is in this way obtained for it. A very pretty instance of this occurs at Cong, in the west of Ireland, where the waters of the great Lough Mask, issuing in a magnificent fall, are dammed up by a wall, and immediately applied to the turning of mills.

The effect of the bore at H, in this Figure, shows how wet grounds may sometimes be drained, by letting down the water into an open stratum below them. The most useful case of this kind, is that of a land-locked bottom, into which the cutting of a main drain through the bank would be attended with very great expense.

Plate CXXXIII. Fig. 12, shows a case of this kind, where the large bottom, EGF, is shut in by the high ground L and M. These grounds, though composed of open rock or gravel, have a cover of clay at least on the side next the hollow, through which the water cannot descend, thereby forming a lake, or at least it descends very slowly, so that the bottom is frequently under water, by which means it is converted into a peat-bog or moss, and gradually fills up with this vegetable matter, until by this means, and the water which it absorbs, the surface swells so far, as to throw the superficial water off by means of the brook AB; while the middle becomes a deep hollering bog, inaccessible to man or beast, except when the sun and wind, by evaporating part of the moisture, have formed a thin crust on the surface.

The obvious remedy is, to lower the outlet, or drive a deep cut, or an underground tunnel, through the ground M, into the lower part of the basin. But this may be too expensive an operation. Examine whether there is not an open stratum below the basin of clay, or one which, if it should be glutted with water, may yet be tapped somewhere, as at B; then, in that case, open a main drain through the middle of the bog, with cross and surface drains, to intercept and deliver the water into the main. In this main there must be smaller holes sunk down into the open stratum; these will swallow up and carry off the water. Care must be taken to prevent the moss and clay from finding its way into the swallow holes, which would soon choke them. For this purpose, a filter of stones, or the like, must be placed round them; or a pipe made of wood, slates, &c to rise something above the bottom of the main drain, which thus becomes a cess-pool. And that they may be as little as possible loaded with foreign waters, form a catch-water round all the bottom in the retentive cover, which may deliver the surface water of the surrounding grounds, by the original lowest outlet gh. The surface of the bog will subside; but as all the drains will subside with it, and the main drain most, they will still continue effective. It is quite unnecessary to cut such drains down to the clay bottom.

One large pit or swallow-hole in the lowest part, would answer equally well for a bog of limited extent, if it could be carried down to the open stratum; and that it would be less liable to choke. The main drain may be led into it; but the drainer must not expect the peat-bog to be bled by such a pit alone, without the assistance of surface drains. Swallow-holes are common enough in the great bogs of Ireland, many of them of great depth and magnitude, usually in limestone rock, and they have obviously been formed after the bog had accumulated; yet they produce very little effect, even very near them, though they may sometimes save expense in cutting drains.

Dr Nugent, in his Travels in Germany, 1766, after describing the mode of surface-draining the moors or turf-grounds, mentions this "practice as of good effect, and chiefly if the moors are not too wet and marshy."

"It is the nature of moors in general, that beneath the turf or moss there is a loam, which hinders the moisture from penetrating; and this, indeed, is what makes the marsh, and causes the luxuriant growth of the turf or moss; but this loam or clay is only a stratum, and far from being of an immense depth. Under it is generally a sand, or some other stony or loose soil."

Here reason informs us, that a middling morass may be drained by perforating the clay, and thus make way for the moisture to penetrate. In order to effect this, a pit is dug in the deepest part of the moor, till they come below the obstructing clay, and meet with such a spongy stratum, as in all appearance will be sufficient to imbibe the moisture of the marsh above. Into this pit the ebbing of the morass is conveyed through a trench, and both the trench and pit are filled up after the first drain with large broad stones, setting them edgewise, so as to leave interstices for the water; then such stones are laid over breadthwise, and these covered with loose earth, like that on the surface. When no such stones are to be had, strong piles are rammed down the sides of the trench, and broad boards laid across, and these are covered with earth to a height fit for culture.

"This is a matter of no great expence, the pit being as near the morass as the water will admit, and the trenches but short. Then they have a drain unperceived, which leaves the surface of the trenches for the plough; and in middling marshes, especially in such moors as are only wet and damp, this method, though sometimes slow, never fails to take effect; and many tracts are thereby made serviceable to the farmer and grazier."

The same practice is known in England. "If a pit is sunk 20 or 30 feet deep in the middle of a field, through the Hertfordshire red flinty and impervious clay into the chalk below, when the usual quantity of chalk is taken out, the pit shaft is filled up with the flints taken out of the chalk and clay, and the top drainage of this part of the field much shortened for ever afterwards, by making principal drains from the part of the field above the level of the top of the pit terminate therein,
and the superabundant moisture will escape through
the flints in the pit shaft to the chalk below; and if a
drain is carried into a limestone quarry, it is seldom
p. 66.

A similar practice is recorded as common in Flint-
shire, where the well is left open, and railed round
against cattle; and the reporter observes, that though
in this and many other instances, the top water esca-
ped through the pervious substratum, the effect might
have been directly the contrary; he therefore recom-
mands the use of boring-rods, as the hole made by
them is easily stopped up.

The employment of boring-rods for this purpose is
mentioned in the Report of Roxburgh, &c.

We may here observe, that the filling up of these
pits with roots of trees, stones, &c. recommended
by some authors, is very injudicious. After incurring
the expense of making them, they ought if possible to
be kept clear; and the filters necessary for that purpose
(of which the cess-pool already mentioned is perhaps
the best) preserved in a situation to be easily accessible.
The sediment may be removed now and then for ma-
ture, and that in the pit taken out by a boring dregge;
whereas the stones and roots could only be cleared out,
by drawing off the water, with great trouble and ex-
 pense. We have seen a bottom of this kind drained,
by cutting horizontally into the open stratum, as GO,
instead of sinking a shaft to it; and perhaps the best
way is to sink a deep cut or shaft, EK, near the edge,
until the gravel, &c., be cut at a proper level; and from
the bottom of this to carry a dregge horizontally towards
the bog, as the work in this way will be dry during
the execution.

The next case for our notice, is that of grounds lying
on the crop or basset of the strata, instead of being to-
wards the dip; the most remarkable effect of which is
the alternate beds of wet and dry soil thereby produ-
ced.

Fig. 13. explains this situation, shewing a hollow in
which there are alternate beds of sand and clay, or the
like, dipping into the hill. This may be considered as
the dry side of the hill, and will, in general, be found
so, provided the different beds of sand have any lower
outlet; for of course all the water they imbibe will run
off by that; but if not, then the water, falling from
the summit O, will sink into the bed of sand KML,1,
and fill it up like a dish, until it run over the lip at
K; then, after keeping the surface K wet by soaking
along the soil, it will subside into the land HFGE. We
may suppose a little of the soil worn down from KH,
to form a cover at the lower edge, of HE forming a
spouting clay. The water running over this, and wetting
the clay bed ED, subsides into the sand DB, which, be-
ing nearly level at top, it completely fills.

Lead up a drain across the different strata at the
lowest place, notching it pretty deep into the upper edge
of the clay, then the water running off from the sands
at lower levels, will not afterwards overflow. If it is ne-
necessary, carry a catch-water k k along the tail of the up-
per sand, which, cutting off the first supply, may perhaps
cure the whole. In the drain, at F, where the tail of
the sand has a covering of clay, sink tap holes in it;
the lower sand DB, which is damp, must be bled by a
deep drain at B, so that this case is reduced to a modi-
fication of the former ones. It is sometimes unnece-
sary to continue the drain through the sand, since that
absorbs the water readily; and it may be collected by
an arm, on either side at the lower edge, into the next
piece of drain which crosses the clay.

Fig. 14. shows the case where the strata are vertical,
or nearly so, and have their edges in the face of the
declinity. The water will here subside through each of
the open strata, and issue at its lower corner as a single
spring; of course there will be a line of these springs
along the foot of every declivity, which are altogether
unconnected with each other; and as the foot of the
declinity will be covered to some height with the rubbish
of the strata above, quicksands and quagmires may
be formed thereby. The remedy is to bring up a cut
for a tail drain BA, to run a drain along under the level
of the springs, and then to make small cuts into every
spring at a proper level in the subsoil; or if the
ground be spotty below them, to sink a tap hole below
each spring in the direction of the stratum.

These different cases comprehend only the simpler
situations which are likely to occur in the practice of
drainage; but, if well understood, they will be sufficient
to direct the operations required for the most complica-
ted. Sometimes, happens, that all the different kinds
of draining are required in one field; at other times,
this great complication is only apparent, as in Figs. 10.
and 12, and one drain, judiciously directed, will do more
than a number run merely at random, without previous
investigation. The first thing required is a

careful examination of the strata; and indeed no per-
son can pretend to skill in draining without some degree
of geological knowledge. The inclination of the strata
must also be examined, to judge how they are connect-
ed with the given site, and how a drain or bore may
be directed to reach the spring. It is proper, therefore,
to examine all places where the strata have been laid
bare, as in cliffs, river beds, wells, ditches, quarries, &c.
in the neighbourhood. Where nothing of that kind oc-
curs, the boring irons must be applied for the purpose,
or pits sunk in the soil. If the water rises in these, the
evil and its cure may be discovered at once, and a drain
opened; but it would be very injudicious to do so with-
out previous investigation. The figure of the
ground must also be considered, as that will lead to a
knowledge of the place where the watery bed bursts
out, or is most accessible, and where drains may be most
advisably placed. The probable supply of water may
also be known in this way.

The spirit level is used for laying out the direction of
the drains, and calculating the expense of cutting them.
The height of water in the interior strata may also be
known thereby, by levelling from the surrounding
springs and wells. A very useful common implement
of that nature is shown at Fig. 15, being a kind of quad-
rant made with stout laths, which may be formed and
graduated any where. (A. N.)

DRAKE, SIR FRANCIS, one of the most distinguished
naval commanders and navigators in the reign of Queen
Elizabeth, was born of obscure parents near Tavistock,
in Devonshire, in the year 1545. He was the eldest of
twelve sons of an honest seaman, and was brought up
in the sea-service from an early period of life, under
the care of his kinsman, Admiral Sir John Hawkins.
At the age of 22, he was appointed captain of the Ju-
dith, in the Gulf of Mexico, where he distinguished
himself greatly in the operations against the Spaniards.
In the year 1570, he made an expedition with two
ships against the same people; and having improved
his fortune, as well as enlarged his experience, he sailed
a second time in 1572, with two ships, one of 75, and

another of 25 tons burden, manned with no more than 73 men and boys. With this inconsiderable force he took first the city of Nombre de Dios, and next that of Vera Cruz, by storm, in neither of which did he find much booty, and in the attack of the former received a very severe wound; but as he was retiring to his vessels, he met unexpectedly with 50 mules laden with silver, of which his people carried off as much as they were able to convey. In these expeditions he was effectually assisted by the Simerons, an Indian nation who were engaged in perpetual hostilities with the Spaniards; and, having received from their chief four large wedges of gold, in return for a cutlass, with which he had presented him, he generously threw them into the common stock. Having embarked his men, and the wealth which he had thus obtained to a considerable amount, he arrived safely in England on the 9th of August 1573.

After his return, he fitted out three frigates at his own expense, with which he served as a volunteer on the coast of Ireland, under Walter Earl of Essex, the father of Queen Elizabeth's favourite; and thus procured, through the influence of Sir Christopher Hatton, the countenance of the court. He had long cherished an ardent wish, though he prudently concealed his plan, to conduct an expedition through the Straits of Magellan into the South Sea; and, having obtained the Queen's permission, he set sail on the 15th of November 1577 with a small fleet of five vessels, of which the largest was only 100 and the smallest 15 tons burden, and the whole of which carried only 164 men. In his course he touched at Mogadore on the coast of Barbary, and opened a friendly intercourse with the Moors; passed Cape Blanco, sweeping the sea of all the Spanish vessels that came in his way, and anchored off the Cape de Verdi Islands in the month of January; but the Portuguese having both refused him here a supply of provisions, and fired upon his ships from St. Jago, he seized upon one of their vessels laden with wine, from which he took the pilot Nuno de Sylva, whose knowledge of the American coast proved of the most essential service to him in his future voyage. On the 5th of April, he made the coast of Brazil, where he took two of his ships, after having taken out the provisions which they carried. On the 20th of May, he entered the port of St. Julian's, where he produced his commission, investing him with the power of life and death; and proceeded to try by a court martial his second in command, Mr John Doughty, upon a charge of mutiny and designs against his life. Doughty having been convicted, partly upon his own confession, and condemned to suffer a capital punishment, was required by Drake to make his choice of one of the following terms,—to be ordered to instant execution, to be left on the adjoining continent, or to be carried to England to stand the course of law. The prisoner having chosen the first, and having received the sacrament along with his commander, whom he also embraced previous to his execution, was beheaded on the spot. This has been censured as the most unworthy act of this celebrated commander, and even as having proceeded in part from private revenge; but though it no doubt demonstrates his deficiency in the quality of mercy, it may, in some measure, be vindicated by the consideration, that, on such distant expeditions, the strictest discipline is essentially necessary, both for the success of the object, and the preservation of all concerned. On the 20th of August he passed the Straits of Magellan; and having now only his own ship the Pelican, (to which in the South seas he gave the name of the Hind,) he continued his voyage along the coast of Chili and Peru, capturing the ships of the Spaniards, and frequently attacking their settlements on the shore. He then proceeded along the western coast of North America as far as the 48th degree, in hopes of finding a passage to the Atlantic; but being disappointed in his plan, he landed upon the adjacent continent, which he named New Albion, and of which he took possession in the name of Queen Elizabeth. Knowing that a return by the Straits of Magellan would expose him, by the lateness of the season, to dangerous storms, as well as to be attacked at a great disadvantage by the Spaniards, he boldly stretched across the Pacific Ocean, and, in less than six weeks, reached the Molucca Islands. Touching at Celebes and Java, he doubled the Cape of Good Hope on the 15th of June, and entered the harbour of Plymouth about the end of September 1580, having completed the circumnavigation of the globe in two years and ten months. The success of his enterprise, and the riches which he had acquired, excited much discussion in England, and very opposite opinions were expressed on the merit of his exploits. Some were disposed to regard him as little better than a pirate, and conceived that the approbation of his proceedings by the government would be attended with fatal consequences to the interests of commerce; while others declared his successful undertaking to be highly honourable to the maritime skill of his country, and his reprisals upon the Spaniards to be fully justified by their own faithless practices. But in the month of April 1581, his majesty gave a public testimony of her approbation of his conduct, by going on board his ship at Deptford, and conferring upon him the honour of knighthood. She also gave directions that his vessel should be preserved as a monument of his own and his country's naval reputation; and whilst the length it began to decay, a chair made of its planks was presented as a curiosity to the university of Oxford. In 1585, he was sent with a fleet of 20 sail to attack the Spanish settlements in the West Indies; and, in this expedition, he took the cities of St. Jago, St Domingo, Carthagena, and St Augustine. In 1587, he was dispatched to Lisbon with a large fleet, with which he proceeded to Cadiz, and destroyed in the harbour more than 10,000 tons of shipping, which were intended for the invasion of England, and afterwards way-laid and captured a rich Spanish Indiaman, the charts and papers of which suggested the first idea of an India company in this country. In 1588, having been appointed vice-admiral under Lord Howard of Effingham, he acted a distinguished part in the attack and destruction of the Spanish armada, and particularly made prize of a large galleon, which yielded without the least resistance to the mere terror of his name. The year following he was entrusted with the command of the fleet which was sent to restore Don Antonio to the throne of Portugal; but owing to a disagreement between him and Sir John Norris, who commanded the land forces, the enterprise completely failed of success. He was still more unsuccessful in 1594, when, in conjunction with Sir John Hawkins, he proceeded upon a second expedition against the Spanish settlements in the West Indies; and by the vexation which this disappointment produced, he was thrown into a lingering fever, of which he died near Nombre de Dios in the month of January 1596, in the 31st year of his age. In his person, Sir Francis Drake was of low stature, but well made, had a broad open chest, a very round head, large clear eyes, a fair complexion, and a fresh, cheerful, engaging countenance. He was thoroughly acquainted with navigation.
in all its branches, and especially with the application of astronomy to the objects of his profession. Though in other respects destitute of education, he possessed a wonderful portion of natural eloquence, and is said to have scarcely ever been heard to utter a feeble or ungraceful expression. He was, on proper occasions, uncommonly generous, but, at the same time, a great economist in the management of his property. Though rather rough and boastful in his manners, he was highly estimable in his private character, anxiously careful of those who were under his command, and displayed the greatest civility and humanity to those whom the fortune of war placed in his power. In all his enter-

D R A M A.

Drama, from the Greek word ὑπάρχειν, is a poem accommodated to action; a poem in which the action is not related, but represented.

The drama is the most directly imitative species of poetry, perhaps the only one that can strictly be said to be imitative.

The drama naturally divides itself into different provinces, according to its means, or according to its ends.

When the means exceed those of mere recitation and simple action, and include dancing and singing, or instrumental music, as important or necessary parts of the performance, we call it Opera, or Melo-drama, and when the subject is sacred, Oratorio. When it excludes recitation, we call it Pantomime. If we divide the drama by its objects, when the end is simply to excite laughter, it is Farce. When rising above the mere object of visibility, it gives a natural, amusing, and interesting draft of manners and character, it is called Comedy. When the end accomplished is to excite sympathy in the strongest degree, and particularly the emotions of compassion and terror, the composition is entitled to the name of Tragedy. To the latter division of the drama, viz., that which arises from the distinction of its objects, we shall principally attend.

As the spectacle of human existence, which the drama professes to imitate, exhibits in the original a constant alternation and mixture of gay and sorrowful objects, it occurs as an obvious question, whether the separation of tragedy and comedy be an artificial or natural distinction? and as a corollary question, whether, on just principles of taste, they ought to be kept separate? we are disposed to say, in answer to the former query, that the distinction is artificial, and, to a certain degree, conventional. Human life, it must be owned, is for ever promiscuous in her exhibitions of the great and the trivial, and of the cheerful and miserable; so that a constant succession of either solemn or mirthful scenes, is a departure from probability. We believe also, that the early history of all national dramas, not even excepting the Greek, would discover them to have been tragi-comic; and the strongest advocates for a legal and secret separation of the gay and the grave dramas cannot deny, that early genius has succeeded in giving pictures of life of this motley contexture, in many instances delightful and faithful to nature. Yet the progress of human taste has also visibly led to demand an unity of effect in all the productions of the fine arts, and as taste is only the power of judging from a comparison of models, it is not a sufficient defence of tragi-comedy, that it pleases a barbarous age. When it is admitted, therefore, that the above distinction of the provinces of the drama is artificial, we must regard the term artificial as denoting the result of human judgment with respect to art. We must not take the word nature, also, in too strict a sense, as the object of the imitation of art. Nature herself, as Sir Joshua Reynolds has observed, must not be too closely imitated. The imitation of existence is only valuable, in as far as it excites a decided and consistent train of emotions. Abrupt or equivocal feelings are much less satisfactory, than the full sway of those, which, by the magic of genius, are made pleasingly continuous and predominant over the whole soul, whether the feelings to be indulged are those of pathos or humour. The only limitation of this general remark respecting the pleasure of human emotions, is, that a certain degree of change may heighten the pleasure by relief. But still that relief must not amount to absolute and extreme contrast. It may be deduced from this reasoning, if admitted, that though the tone of tragedy and comedy may occasionally approach each other, their highest characteristics should never be equivocally blended.

Tragedy has been justly defined by the ingenious Hurd, Tragedy, to be that species of dramatic composition, of which the end is, to excite the passions of pity and terror, and perhaps of some others nearly allied to them. From this definition of the objects of tragedy, he concludes that actions, not characters and manners, are the chief objects of representation. By curiosity in actions and events, our hearts are moved; by curiosity in manners and characters, our minds are amused. In our deep emotion at a tragedy, it is the fortunate or unfortunate issues of events, that, in the first instance, agitate our hearts;—plot and solid action are of the first consequence to tragedy. Still the manners and characters are so far essential to it, that our grief or joy in the catastrophe, depends on our love or hatred of the leading characters; and the probabilities and truth of manners are indispensable to create illusion, and to secure our belief. The genius of comedy, while it implies that Comedy, display of humour which provokes risibility, supposes also genuine representations of nature, (not caricatures, like farce,) and derives its beauty, perhaps, in the first degree, from fidelity to the truth of life. As a painting of familiar nature, comedy classes and specifically distinguishes the difference of human character, and in the perfection of the art, requires, no less exclusively, and more minutely than tragedy, an observation of all the shades and varieties in the moral physiognomy of man.
Thus in comedy, though a plot be necessary, yet a good plot is not so essential to it as to tragedy. On the contrary, too good a plot, if I may say so, that is, a plot which draws away our curiosity from character to incident, is destructive of the highest excellence of comedy. This is remarkably felt in those busy plots, where the authors have themselves the trouble of painting human nature by surprising events and sudden revolutions. Passions in a tragedy, on the contrary, is the result of the entire action, i.e., of all the circumstances of the story taken together, comprising the complex of events. Comic humour in barbarous times is all practical; in refined times, it becomes spiritual. The simpleton of Molière is exquisitely ludicrous, when he embraces the greatest rogue on the face of the earth, and supposes him the only honest man in Paris. In a Spanish plot, the humour would not be in supposing a rogue an honest man, but in mistaking one person for another. A failure, as Hurd observes, in the just arrangement and disposition of the parts, may then affect what is the essence of tragedy. On the contrary, humour, though brought out by action, is not the effect of the whole, but may be distinctly evidenced in a single scene; as may be eminently illustrated in the two comedies of Fletcher called The Little French Lawyer, and The Spanish Curate. The nice contexture of the fable, therefore, though it may give a pleasure of another kind, is not so immediately required to the production of that pleasure, which the nature of comedy demands. Much less is there occasion for that labour and ingenuity of contrivance, which is seen in the intricacy of the Spanish fable. Yet this is the taste of our comedy; our writers are all for plot and intrigue, and never appear so well satisfied with themselves as when (to speak in their own phrase) they have a great deal of business on their hands. Indeed they have reason, for it hides their inability to colour manners, which is the proper, but much harder province of true comedy. When Hurst said this, Sheridan had not revived the genius of British comedy; but there is something in the remark which still applies to the plot-makers of the present stage. Tragedy, he adds, succeeds best when the subject is real; comedy, when it is feigned. What would this say, but that tragedy, turning our attention principally on the action represented, finds means to interest us more strongly, on the persuasion of its being taken from actual life; while comedy, on the other hand, can neglect the scrupulous measures of probability, as intent only on exhibiting characters, for which purpose an invented story will serve much better. The reason is, real action does not ordinarily afford variety of incidents enough to shew the character fully; feigned action may.

And this difference, we may observe, explains the reason why tragedies are often formed on the most trite and vulgar subjects, whereas a new subject is generally demanded in comedy; the reality of the story being of so much consequence to interest the affections, the more known it is, the fitter for the poet's purpose. But a feigned story having been found more convenient for the display of characters, it grew into a rule, that the story should be always new. — One sees then the reason why tragedy prefers real subjects, and even old ones; and, on the contrary, why comedy delights in feigned subjects, and even new. — The same genius in the two dramas is observable in their choice of characters. Comedy makes all characters general; tragedy particular. — My meaning (continues Hurd,) is, that they are more particular than those of tragedy; for in

the former, no more character is shown than what the course of the action necessarily calls forth; whereas in the latter, viz. comedy, all, or most of the features by which it is usually distinguished, are sought out and industriously displayed.

In the rudest stages of society, we hardly ever find poetry separated from the passions and affections of man; but dramatic poetry, being more complicated in its nature than either the lyric or epic kinds, might be expected to be the last which should become other: and in fact, when the drama first arose in the region of antiquity, which may be called its birth-place, it was not till four hundred years after Homer had brought epic poetry to perfection. The earliest drama that is known is the Greek. Tragedy, or the song of the goat, from παίζεσθαι, a goat, and σαίνο, a song, was among that people at first only a sacred hymn. Bacchus being worshipped as the inventor and cultivator of the vine, the goat was sacrificed to him as its destroyer; — the sacrifice grew into a festival, and the festival into an annual solemnity, which, in process of time, assumed all the pomp and splendour of religious ceremonial. Poets were employed by the magistrates to compose hymns or songs for the occasion; and such was the rudeness and simplicity of the age, that their hands contended for a prize, which, as Horace intimates, was scarce worth contending for, — vicem ob hicem — being no more than a goat, or goat-skin of wine, which was given to the successful competitor.

This was probably the period when Thespis first pointed out the tragic path, by his introduction of a new person, who relieved the chorus, or troop of singers, by reciting part of some well-known history or fable, which gave time for the chorus to rest. All that the actor repeated between the songs of the chorus was called an episode, or additional part, consisting often of different adventures, which had no connexion with each other. When tragedy assumed a regular form, these recitations, which, during its imperfect state, were only adventitious ornaments, became the principal and constituent parts of the drama; the subject of them drawn from one and the same action, retaining the name of episode. Thus the chorus, or song, which was at first the only, and for a long time the principal performance, became gradually and insensibly an inconsiderable, though, according to the structure of the Greek drama, an indispensable part.

From this time, we may imagine the actor or reciter was more attended to than the chorus, as his part had the charm of novelty to recommend it. The songs of the chorus also began to wave from their original subject in praise of Bacchus, and spoke so little of the god of the vintage, that the priests exclaimed against the neglect of him, and their complaint grew into a proverb. From the time of Thespis to that of Aeschylus, however, the history of the Greek drama (if the name can be applied to their strolling performances) is all darkness and conjecture. Tragedy might be said to be created by Aeschylus, who, living in Athens at the brilliant period of the battles of Marathon and Plataea. Fifty years before his time, Thespis had exhibited his rude performances in a cart, and besmeared the faces of his actors with the lees of wine, either for drollery or disgrace. Aeschylus, who was himself author, actor, and manager, took upon him the whole conduct of the drama, improved the scenery and decorations, and brought his actors into a regular and well-constructed theatre; raised his heroes on the euthymus or huskin, invented masks, and introduced splendid habits, with sweeping
trains, that gave an air of dignity to his performers. In order to form any just idea of this primitive form of tragedy which Aeschylus introduced, we must, in the first place, dismiss the idea inculcated by the general mode of printing the Greek plays, that they were divided, like our own, into five acts. The allusion of Horace, it is true, to that number of acts, shows that the Romans had such a division; but the ancient Greek drama was undivided. The oldest editions of the Greek tragedies do not so much as mark a separation of the scenes; and the word act does not occur in that treatise of Aristotle, which gives us a definition of every part of the national drama. The only acknowledged division applied to tragedy, by the critics already mentioned, was its beginning, middle, and end—the prologue, episode, and exode—a division rather formed by the mind of the reader or spectator, than presented mechanically to his eye. The prologue was not like that address to the audience, which passes with us by that name; it was the opening or exposition of the piece, containing all the circumstances necessary to be known, which might not according to Aristotle give an insight into the plot. By the episode was meant all the part of the piece containing the substance of the plot; and the exode contained all the unravelling or catastrophe. But the most remarkable feature of difference between the ancient drama and our own, was the chorus, a group of personages not uninterested in the issue of the events that were going on, but acting chiefly as advisers and confidants of the principal characters. As the principal characters were supposed to be too busy and impassioned in the course of events, the chorus uttered whatever moral reflections the scene suggested; they augmented the pomp of the play by their parades, and they heightened the delight by their music, and (though it ill accords with our idea of the serious drama) by their dancing. In fact, the ancient Greek tragedy must have borne a strong resemblance to the modern Italian opera. The number of persons composing the chorus was probably at first indeterminate. Aeschylus, we are told, brought no less than fifty into his Eumenides, but was obliged, by the civil authority, to reduce them to twelve. Sophocles was afterwards permitted to add three, a limitation which, we have reason to imagine, became a rule to succeeding poets. To modern popular taste, as indeed experience has proved it, nothing is less conducive to dramatic illusion, than a group of such half neutral and moralizing personages as the ancient chorus exhibited. Yet the chorus has found its advocates even among a high order of men of taste and genius. Milton, in his zeal for classic lore, wrote his Samson Agonistes, on the severest model of antiquity; and Mason endeavoured, though without much success, to familiarize a British audience with the lyrical strophes and antistrophes of choral poetry. In justification of this attempt, he contends, in a letter prefixed to his Elfrida, that whatever play-makers may have gained by rejecting the chorus, the true poet has lost considerably by it. For he has lost a graceful and natural resource to the embellishment of picturesque description, sublime allegory, and whatever else comes under the denomination of pure poetry. "Shakespeare," he says, "had the power of introducing this naturally, and, what is most strange, of joining it with pure passion; but I make no doubt, if we had a tragedy of his formed on the Greek model, we should find it more frequent, if not nobler instances of his high poetical capacity. I think you have a proof of this in those parts of his historical plays, which are called choruses, and written in the common dialogue metre. And your imagination will easily conceive, how fine an ode the description of the night preceding the battle of Agincourt would have made in his hands, and what additional grace it would receive from that form of composition." He proceeds, in another letter, to notice that superior variety and majesty, which the chorus necessarily added to the scene of the drama, by uniting the harmony of the lyre to the pomp of the bascin. The point on which he chiefly insists is, that of its being a vehicle for moral and sentiment, so material that he conceives nothing can atone for the want of it. In these parts of the drama (he says) where the judgment of a mixed audience is most likely to be misled by what passes before the view, the chief actors are generally too much agitated by the fervours passions, or too much attached by the tender ones, to think coolly, and impress on the spectator a moral sentiment properly. A confidant, or servant, has seldom sense enough to do it; never dignity enough to make it regarded. Instead, therefore, of these, the ancient poets resorted to the chorus; they were not only capable of seeing and hearing, but of arguing, advising, and reflecting."—"If you ask me, (he continues,) how it augmented the pathetic? I cannot give you a better answer than the Abbé Vatry has done in his dissertation on the subject, published in the Mémoires de l'Acad. des Insd. &c. It effected this," says he, "both in its odes and dialogue. The wonderful power of music and the dance is universally allowed; and as these were always accompaniments to the ode, there is no doubt but they contributed greatly to move the passions. It was necessary, that there should be odes or intermedes, but it was also necessary, that these intermedes should not suffer the minds of the audience to cool; but, on the contrary, should support and fortify those passions which the previous scenes had already excited. Nothing imaginable could produce this effect better than the choral songs and dances, which filled the mind with ideas corresponding to the subject, and never failed to add new force to the sentiments of the principal personages. In the dialogue, also, the chorus served to move the passions, by shewing to the spectators other personages strongly affected by the action. A spectacle of such a kind, as is fitted to excite in us the passions of terror and pity, will not of itself so strongly affect us, as when we see others also affected by it. The painters have generally understood this secret, and have had recourse to an expedient similar to that of the chorus of the poets. Not content with the simple representation of an historical event, they have also added groups of assistant figures, and expressed in their fancies the different passions which they would have their picture excite. Nay, they sometimes enlist into their service even irrational animals. In the slaughter of the Innocents, Le Brun was not satisfied with expressing all the horror of which the subject is naturally capable—he has also painted two horses, with their hair standing on end, and starting back, as afraid to trample on the bleeding infants. This is an artifice which has been often employed, and which has always succeeded. A good poet should do the same; and Iphigenia should not be suffered to appear in the theatre, without being accompanied with persons capable of feeling her misfortunes." Specious as these arguments are, the reflecting reader may have probably anticipated many answers to them.

If the chorus excluded those nuisances of the modern stage, insipid confidants, who are introduced only
for a pretext to let the hero or heroine tell their own
story, the ancient stage substituted what was worse,
whole trains of secret-bearers and confidential advisers.
The chorus prevented soliloquies, which, with us, are
often insipid; but who would exchange such a solilo-
quy as that of Hamlet or Wolsey, for any speech that
could be made to a chorus? The circumstance of the
chorus being unable to follow individuals into privacy,
was in fact a detriment to the Greek stage; for it obli-
ged them to receive secrets in public places, where it
is revolting to think of such communications being
made; as, when Oedipus tells of his incest in the
public street. *Ille bonis joveant,* says Horace, speaking
of the chorus, they are to take the side of the good
and virtuous; but this was not universally the moral merit
of the Greek chorus. The chorus in Antigone, (a tra-
gedy of the moral Euripides), takes the side of the
wicked. It consists of a number of old Thebans, as-
sembled by the order of Creon, to assist at a mock
council, in which he meant to issue his cruel interdict
of the burial of sepulture to the body of Polyxena. This
veteran troop of vassals enter at once into the horrid
views of the tyrant. Besides, the chorus, though in
general moral and friendly advisers, were, from their
confidential character, frequently obliged to be the de-
positaries of horrid intentions, which it would have
been inconsistent with the progress of the plot, as well
as with their characters, if they should have revealed.
With regard to the external pomp and beauty of the
chorus, it is certainly in the power of modern tragedy
to atone for the deficiency of these, by a stronger de-
velopment of the heart; and if the poet cannot inter-
weave in his dialogue the charms of fancy, feeling, and
moral reflection, we shall hardly expect them in a cho-
ral shape. What we have lost by disusing dances in
tragery, it is difficult to conceive; and though the union
of music with poetry may occasionally heighten its ef-
effect, still we know that the Italian operas, which is in
fact the linear descendant, and nearest resemblance of
the ancient Greek drama, has been rather unfavoura-
ble than propitious to the dramatic poetry of Italy.—

To return to *Eschylus:* Only seven of the pieces, out of
ten times the number which he is said to have writ-
ten, have come down to posterity. All these tragedies
betray the infancy of the dramatic art; their beauties
are rather epic than tragic; they display a genius of
bold and gigantic, but of rude character, nourished on
the poetry of Homer, and doing little more than dra-
maticizing his scenes. Indeed, *Eschylus* used to say, that
his pieces were but dishes from the feast of the *liad.* His
seven pieces that have reached us, are, the Pro-
metheus bound—The Persians—The Seven Chiefs be-
fore Thebes—The Suppliant—his Agamemnon—The
Furies—and The Charphoeus. The subject of Prom-
metheus is too mythological to be interesting;—Vulcan,
accompanied by Strength and Violence, the minister of
Jupiter, chains Prometheus to a rock for having stolen
fire, and taught the arts to mankind. The Ocean, and
the ocean Nymphs, and Io, come to listen to the com-
plaints of Prometheus, whom Mercury summons to
tell the secret of which he boasts, namely, the means
which Jupiter may employ to save himself from being
one day hurled from the throne of heaven. Prometheus
haughtily persists in refusing to tell the secret—the
thunder descends, and the sufferer is left to his rock
and tormenting vulture. In all this, it is difficult to
discover any thing moral or affecting. The subject of
his Persians, is the defeat of that people at Salamis;
it is full of recitations, descriptions, prayers, dreams,

and laments, without any regular or interesting
plot. Some aged men, who compose the chorus, await
with anxiety for news of Xerxes' expedition—Atossa,
the mother of Xerxes, relates to them a dream which
has terrified her—A soldier arrives from the army, who
describes the disasters of the Persians—Atossa conjures
up the shade of Darius; and, contrary to the ordinary
intelligence which we expect from such visitors, the
spectre comes, not to reveal a secret to the living, but
to hear from Atossa what has been lately told her by
the messenger, of the defeat of Xerxes. Towards the
close of the play, Xerxes arrives, and is saved with
abundance of trouble: he weeps and groans, and does
little more than recommend to his mother and the old
men, to weep and to groan in concert with him. The
whole tragedy is one tissue of the praises of Athens—
the terrors, the humiliation, and the tears of the Per-
sians. It is easy to conceive a self-sufficient republican
people, intoxicated with recent glory, receiving such a
piece with applause. After the defeat of the Athenians
in Sicily, such extravagant praises would not, perhaps,
have been a substitute for dramatic entertainment.
*Eschylus* tragedy on the death of Agamemnon, has
beauties of a higher cast. There is, it is true, too much
exposition of the catastrophe before it happens, and
the atrocity of Clytemnestra is frigid and unexplained
by sufficient motives. She is neither apparently very
jealous, nor impelled to revenge by any passion that
speaks aloud; she is merely desirous of killing her
husband. Now, in the drama, actions are interesting
only in proportion to the strength of their motives.
We may shudder at motives, but we should never be
left doubtful of their existence or of their impulse,
however criminal it may appear. The tragedy, how-
ever, has traits of sublime and impressive terror in the
part of Cassandra, the Trojan prophetess, who is brought
home a captive, and foresees, though she cannot com-
municate her prediction, so as to be intelligible to those
whom she warns of the impending murder. The pas-
sage is peculiarly fine, when the chorus thus address
her:

Thy own woes thou wallest,
In mournful melody, like the sweet bird
That darkling pours her never-ceasing plaint,
- - - - - - - - and wastes,
In sweetest woe, her melancholy life.

She replies,

"Ah me! the fortune of the nightingale
Is to be envied; on her light poised plumes
She wings at will her easy way, nor knows
The anguish of a tear; whilst on my head
The impending sword threatens a fatal wound."

There is great energy in one of the subsequent bursts
of her agony:

"I burn, I burn, Apollo! O, Apollo!
This likeness, that in a sensual sky
Roll'd with the wolf, (the generous Lion absent,)"
Will kill me! And the sorceress, as she brews
Her filtered cup, will drug it with my blood.
She glorifies, as against her husband's life
She whets the axe—her vengeance falls on him;
For that he came accompanied by me.
Why do I longer wear these useless honours,
This laurel wand, and these prophetic wreaths?
Away! Before I die I cast you from me.
- - - - - - - -

Thou Sun, whose rising beams shall bless no more
These closing eyes! You, whose vindictive rage
Drama.

Hangs o'er my hated murderers, avenge me!

This is the state of man; a passing shadow
Throws down the baseless fabric of his joy;
And when the tablet of his fleeting state
Is character'd with all fidelity,
Comes malice with a sponge, moistened in gall;
And wipes the benogenous images away. *

In three successive tragedies, Æschylus has followed out the history of Agamemnon's family. In Agamemnon, the prince is killed. In the Oreste the death of his son Orestes; and in the Eumenides, Orestes is pursued by the Furies. The two last pieces have something of a nearer approach to that progressive and involved action, which is necessary to an interesting drama. Of the two, the Oreste is perhaps the first piece deserving the name of a tragedy, with which the history of literature presents us; for the Prometheus, the seven chief, the Persians, the Suppliants, and even his Agamemnon, can hardly be pronounced more than terrific theatrical pageants.

From the time that the serious drama commenced in Greece with Æschylus, there appeared in the space of about half a century after him, Sophocles, Euripides, Cherrillus, Aristarchus, Empedocles, Ion, Nonachus, and Cephalus, who disputed for the prizes of tragic genius at the Olympic games before assembled Greece. The fertility of their genius appears immense, when we consider that Æschylus wrote eighty pieces; Sophocles, an hundred and twenty; Euripides, ninety; Cherrillus, an hundred and fifty; and their rivals nearly as many. The entire works of none of those authors have come down to posterity; but from those which have reached us, of the three great masters, the general opinion has assigned the palm of sublimity to Æschylus, of pathos and sentiment to Sophocles, and of tragic art to Euripides. In the plays of Sophocles, however, wetrace a wonderful progress of the art from its crude, though sublime, immaturity in the works of Æschylus. He seems to have had in his mind's eye, a fine idea of the general characters by which human nature is distinguished. He drew mankind such as they should be. We find in him, elevation, dignity, ideal beauty of human character, particularly in his high-minded portraiture of Neoptolemus. His plays have a noble, not a desolate, simplicity; like those of Æschylus, they have plot sufficient to awaken attention, and keep it alive by tender, as well as terrible, emotions. This remark will be found particularly applicable to the sympathy which he excites for the sorrows of Teemessa, the wife of Ajax, in the tragedy bearing that name, and in the two-fold distress of Philoctetes;* and the generous son of Achilles; the one clinging to his benefactor to save him from the desert island, and the other distracted between his duty to Greece and his compassion for the unfortunate man. Sophocles drew men according to the general outline of the ideal beautiful. Euripides, it is alleged, came closer to individual nature, and drew men as they really are. Notwithstanding a passage in Aristotle, which seems to admit, that this was the general opinion of their contemporaries, we confess that, with all deference to higher authority, we are not convinced of the justice of this distinction. The characters of Sophocles, we venture to think, are as entirely true to nature as those of the later dramatist, at least their expressions seem to come more immediately and truly from the heart. Every one must, however, acknowledge Euripides to be, as Aristotle pronounces him, the most tragic of poets. By studying and refining on preceding models, he contrived more consummately tragic situations. He found in, Sophocles sufficient proofs that the natural affections are the first resources of the pathetic. He completed his pictures of these with higher art; he combined the tenderness of Sophocles with the terrors of Æschylus; and new-modelled some of the stories of the former with a splendid and fancy peculiar to his genius. His tragic creations are richer and more full of picture and incident than those of Sophocles. It may be doubted if he any where keeps the heart in more terrible suspense than Sophocles does in his Oedipus; but he launches bolder passions on the stage, as in the jealousy of Medea, and in the love-born frenzy of Phaedra.

We have noticed already the resemblance of ancient tragedy, to modern opera. This circumstance is too important to be slightly passed over. Aristotle tells us in his Poetics, that music (Melopoeia) is an essential part of tragedy; but how it became essential, this philosopher does not inform us. M. Dacier has endeavoured to supply this omission, by suggesting that custom, and the natural passion of the Greeks for music, had incorporated it into their drama. Perhaps the festive origin of tragedy, already mentioned, points it out much better than Dacier's commentary. It explains, at least, sufficiently the musical nature of the choruses. Nor, as Dr Burney has observed, will the custom of setting the acts of a play to music, appear strange to such as recollect that they were written in verse, and that all verse was sung, particularly such as was intended for the entertainment of the public, assembled in spacious theatres, or in the open air, where it could only be heard by means of a very slow, sonorous and articulate utterance. It is true, continues the same writer, that tragedy is an imitation of nature; but it is an exalted and embellished nature; take away music and versification, and it loses its most captivating ingredients. Those who think it unnatural to sing during distress, and the agonies even of death, forget that music is a language that can accommodate its accents and tones to every human sensation and passion; and that the colouring of these upon the stage must be higher than in common life, or else why is blank verse, or a lofty figurative language, necessary? * From these and other circumstances, Dr Burney observes, there can remain no doubt but that the ancient dramas were sung. Dramatic representation having been constantly called by the Greeks μίσρη melody, and by the Latins modulatio cantum, and other musical terms which imply singing. Indeed, so immense was the size of the theatres of Greece and Italy, that we may naturally conclude a musical declamation to have been a necessary consequence of speaking loud; for whoever shouts, halloos, or bawls with sufficient force to be heard farther than common speech can penetrate, makes use of fixed-tones, which if softened would become musical; and it is well known that the tones of speech are too transient and undetermined to be ascertained by those of music, or to be

* We have ventured to make a slight change from the translation of this passage by Potter.
† In the tragedy of Philoctetes.
‡ These we give as Dr Burney's ideas on melo-drama, which, however, his own opinion of the Opera, in another passage, rather contradicts.
audible at a great distance, or in a wide space. This want of natural power of voice sufficient to be heard in the open air, (for the ancient theatre had no permanent covering,) gave rise not only to singing upon the stage, but perhaps to chanting in the church.

The necessity of augmenting the performers' voice by every possible means, likewise first suggested the idea of metallic masks, which were likewise used by the actors upon the principle of speaking trumpets, and that of the echeias, or harmonic vases; two expedients so peculiar to the ancient drama, that it seems necessary to give some account of them. The mask was called by the Romans persona, from personare, "to sound through;" and delineations of such masks as were used in each piece were generally prefixed to it, as appears from the Vatican Terence. Hence dramatis persona, "masks of the drama," which words after masks ceased to be used, were understood to mean persons of the drama. Quintilian, lib. ii, gives a list of invariable masks appropriated to different characters, to which the public had for many ages been accustomed; and Julius Pollux is still more ample in his account of theatrical masks, used in tragedy, satire, and comedy.—Niobe weeping, Medea furious, Ajax astonished, and Hercules enraged. In comedy, the slave, the parasite, the clown, the captain, the old woman, the harlot, the austere old man, the debauched young man, the prudent young woman, the matron, and the father of a family, were all constantly characterized by particular masks. This custom is, in some measure, still preserved in the Italian comedy, and in our pantomime entertainments, which originated from it. "The spectators," says De Bos, speaking of the ancient theatre, "lost little on the side of face-playing by the introduction of masks; for not one-third of the audience were near enough the actor to discern the play of muscles, or workings of the passions in the features of the face, at least to have received pleasure from them; for an expression must have been accompanied with a frightful grimace and distortion of visage, to be perceptible at so great a distance from the stage." With respect to the echeia or vases, the historian of music already quoted observes, that they were used in theatres for the augmentation of sound. Vitruvius, b. v. ch. v. tells us, that they were placed in cells or niches between the rows or seats occupied by the spectators, to which the voice of the actor had free passage; that they were made of brass or earthen ware, and proportioned in magnitude to the size of the building; and lastly, that, in the small theatres, they were tuned in the proportions of fourths, fifths, and octaves, with their replicates; and in theatres of great magnitude, there was a vase to correspond with every sound in the disdiapason, or great musical system, in all the genera. From the existence of those vases, Dr. Burney concludes, that the voices of the actors approached them in fixed and musical tones, modulated in unison with the tones of the vases. Plutarch tells us, that the dithyrambic and tragic poets adopted for their pieces that kind of musical execution, of which Archilochus performed the music to his iambic verses in two different ways, rectifying some of them with an accompaniment, and singing others, while instruments servilely performed the same notes as the voice; and this was the method which the tragic poets afterwards adopted. We learn from the same work of Plutarch, that even the declamatory iambics were accompanied by the ethara, and other instruments; but as the employment of the ethara upon these occasions was not constant, it seems, says Dr. Burney, as if only the general tone of declamation was given to the actor by the musician, as the chord is given to the singer in modern recitative; whereas in the chorus, and other poetry that was sung, the instrument constantly accompanied the voice note for note. Dr. Burney's conclusion is, therefore, that the ancient dramatic writers used a different kind of music for the declamation of the actors, and for the songs of the chorus; the one may perhaps be compared to modern recitative, and the other to chanting in the Roman church. That this music was simple, and intended to render speech more articulate, as well as to fortify passion, both reason and the authority of ancient writers enable us to believe. Plutarch says, that "the choral genius was never used in tragedy." Now if the ancient drama was declared in a species of recitative, it will bring it still nearer the recitative of modern musical dramas, in which no chromatic is ever admitted. Plutarch likewise informs us, that a strict rhythm or measure was not observed in tragedy; another circumstance resembling modern recitative, in which no time is kept but that of the accent and cadence of the verse. And this assertion of Plutarch seems to agree with what Aristotel says in his Poetics, chap. 1. that the dithyrambs, nomes, tragedies, and comedies, use a like number, verse, and harmony, with this difference, that in some all three are employed at once, in others they are used separately. By number or
rythm is here meant regular time, and by harmony mu-

song. In dithyrambs and odes, the verse was always accompanied by melody, rythm, and dance; and in tragedy and comedy, the verse was only recited dur-
ing the tragedy, (we should rather say in all the parts not choral,) but in the choruses it was accompanied by sing-
ing and dancing. The custom of dividing the action from the declamation, ascribed very absurdly by some modern writers to the ancient stage, is quite incredible, and without authority. It is mentioned by Livy, as hav-
ing been done by Livius Andronicus, an old Roman poet, in order to save himself the fatigue of singing in his own piece. The passage of Livy, however, according to the suggestion of M. Duros, may be understood with more probability to imply, that the old poet, who at first sang his canticum, and afterwards danced in the inter-
cludes, alternately having sung till he was hoarse, trans-
ferred the singing to another performer, in order to dance with more force and activity; and that the ode was the custom of making singing and dancing two different pro-
cessions. The story, when applied to the separation of speaking and acting, becomes absurd and incredible.

To speak generally of the Greek tragedy, the works of it which have reached us, certainly present most interesting and beautiful relics of human genius. As an order of dra-
matic architecture, if we may so speak, it was simple, stupen-
dous, and severely regular in its proportions; though some of the wandering plots of Euripides may be deemed an exception to this rule. It was, however, rather the show of events, than of characters or passions; and to one accustomed to the full development of the heart in modern tragedy, the reserved and concentrated expres-
sion of ancient heroes on the stage, will sometimes ap-
pear as unnatural as the masks which they wore. In one respect, modern opinion seems to have done them too much justice. The Greek tragedies were simple, but not so free from tragi-comedy, as may be generally imagi-
ned. If that be tragi-comedy which is partly serious and partly comic, we need not scruple to say, that the Alcestes of Euripides is, to all intents and purposes, a tragi-comedy. There can be little doubt that it had, upon an Athenian audience, the proper effect of tragi-
comedy; that is, that in some places it made them cry, in others laugh. And the best thing we have to hope for the credit of Euripides, is, that he intended to pro-
duce this effect; for, though he may be an unskilful poet who purposes to write a tragi-comedy, he is surely still more unskilful, who writes it without knowing it. We par-
cicularly allude to the scene in which the domestic in Alcestes describes the behaviour of Hercules, and to the speech of Hercules himself which follows. The servant describes the hero as the most greedy and ill-mannered guest he had ever attended under his master's hospitable roof, calling about him, eating, drinking, and singing in a room by himself. While the master and all the rest of the family are in the height of funeral lamentation, he was not contented with such refreshments as had been set before him, but drinks, croaks himself with myrtles, and sings ΑΜΟΤΕΥΩ ΤΑΛΚΡΟΝ, and all this alone.

"Cette description (says Fontenelle) est si burlesque qu'on dirait d'un crocheteur qui est de contrariete." A censure somewhat justified by Euripides himself, who makes the servant take Hercules for a thief. The speech of Heracles philosophizing in his cups, is still more cu-
rious. It is indeed full of the ΠΑΣ ΟΡΙΟ, and completely justifies the attendant's description. It is a true drink-
ing song, recommending the servant to uncloud his brow, enjoy the present hour, think nothing of to-mor-
row, and drown his cares in love and wine. In another tragedy of the grave Euripides, of which only some frag-
ments remain, entitled Menalippe the Wise, there must have been tragi-comic matter of a still more cu-
rious kind. Menalippe was delivered of two children, the fruits of a stolen amour with Neptune. To conceal her shame, she hid them in her father's cow-house, where he found them; and being less of a philosopher than his daughter, took them for a monstrous produc-
tion of some of his cows, and ordered them to be burned.

His daughter, in order to save them without exposing herself, enters into a long physical argument to cure her father of his unphilosophical prejudices about monsters, and portentous births; and to convince him that these children might be the natural offspring of his cows.

The truth is, that we may plainly trace in the Greek tragedy, with all its improvements, and all its beauties, pretty strong marks of its popular and tragi-comic origin; for though the festival of Bacchus was a religious cere-
mony, we must not attach to the religion of antiquity, especially to the worship of Bacchus, the ideas of purity and serious devotion, with which Christianity is invested.

Tragodía, or the Song of the Goat, we are told, was or-
ginally the only dramatic appellation; and when after-
wards the ludicrous was separated from the serious, and distinguished by its proper name of comedy, the se-
paration seems to have been imperfectly made, and tragi-
drama, distinctively so called, seems still to have retained a tincture of its original merriment. Nor will this ap-
pear strange, when we consider the popular nature of the Greek spectacles. Even comedy among the Greeks, in its broadest and most farcical state under Aristophanes, par-
took visibly, on some occasions, of the magnificence, though not of the pathos, of the serious drama. Every one who recollects the choruses of Aristophanes in his "Clouds," will acknowledge that the poet often writes most beautiful and serious lyric poetry; not indeed tragi-
comedy, or moving, but splendid, fanciful, and metaphorical, above the tone of comedy.

The comic drama was not at first cultivated in Greece with the same care as tragedy; but the gaiety of Athens gave it also its reign, and although the man-
ners of Greece never seem to have favoured its true polish and refinement, yet this was not for want of comic writers, since from their earliest one, Crater, to the rise of the Roman stage with Plautus, an int-
erval of two ages, there are reckoned fifty comic poets.

Of these, Aristophanes composed fifty comedies, and Menander and Cratinus one hundred each. Of none but of Aristophanes has any entire play come down to posterity. The Greek comedy has been divided into three epochs; the old comedy, the middle, and the new. The old comedy was mere scandal in the shape of dia-
logue, which launched individuals by their proper name upon the stage. Aristophanes flourished in what was called the period of the old comedy. In the old comedy, the individual object of ridicule was named by his pro-
per name; in the middle comedy, the dramatist was obliged to give a fictitious name to his characters; in the new and civilized comedy, general and purely fictitious characters were substituted for the former scandalous species of satire, before the comic art had aspired to that generalization of character and refinement of spirit, which gives it dignity to rank as the counterpart of tragi-

General character of the Greek tragedy.

Greek comedy.

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Drama.  Comedy, (as an eloquent living writer has observed,) requires a much deeper and more extensive knowledge of the human heart than tragedy: it is less difficult to portray what so frequently strikes the imagination as the picture of distress; it may also be admitted, that tragic characters bear a certain resemblance towards each other, which excludes critical observation, and the models of heroic history have clearly pointed out the path which they should pursue. But it was the process of ages to bring the understanding to that requisite degree of taste and superior philosophy which distinguished the dramatic works of Moliere; and even had as great a genius as this author existed among the Athenians, they would not have understood the beauty of his productions. The taste of the Greeks, (that sensible authoress continues to remark,;) was only good when it was annexed to the imagination—objects of enthusiasm—but defective when it arose from morality and sentiment. The exclusion of women from the Greek theatres, was one of the chief causes of its imperfections; the authors having no motive for concealment, there was no restriction of language necessary to be observed; they were consequently deficient in grace, elegance, and modesty. The use of masks, and speaking trumpets, and all the fantastical customs of the ancient theatre, disposed the mind, like caricatures in drawing, to study the grotesque and unnatural. Aristophanes sometimes availed himself of the gross jests and buffoonery of the populace—he likewise presented the reverse of what was vulgar and inelegant, but it was never a clear representation of situations, or an accurate description of characters, that he explained.

The greater part of his dramatic works were relatively connected with the events of the times in which they were written. The art of inquiring popular curiosity by a romantic intrigue was yet unknown; it was always an easy matter to please the people, by turning their chiefs into derision. The comedies of Menander and Theophrastus made a great progress in dramatic decency, and in the knowledge of the human heart; both these writers had the advantage of living a century after the time of Aristophanes, when the licentiousness of an Athenian democracy must have been so unfavourable to the fine spirit of comedy. The high character of Menander, which is given by Plutarch, leaves us room to lament, that only fragments of his works have been preserved.

That idolatry which we pay to Shakespeare seems to have been paid to Menander by antiquity. "Oh! Menander and Nature," says Aristophanes the grammarian, "which of you copied from the workmanship of the other?" and Julius Caesar, in giving Terence the name of half Menander, and at the same time lamenting his deficiency in the vis comica, implies that the Greek dramatist possessed the latter gift in common with the qualities so much admired in the Roman. Besides their regular comedy, the Greeks had dramatic ΣΑΤΥΡΙΚΑ, or farces, which were probably the most ancient species of dramatic writing. These satires were so called from their actors, who personified the Satyrs, the imaginary attendants of Bacchus. The only specimen which we have of this species of entertainment, is the Cyclops of Euripides, which is, in fact, like Tom Thumb, a tragedy burlesqued. They were performed, says Mr Pinkerton, between the acts of the comedies or tragedies. Mr Pinkerton should have known, that the Greek drama had no acts nor intervals.

Masters as the Romans were of the ancient world, they were in literature only the scholars of the Greeks. It appears, indeed, from a passage in Varia, who speaks of an author of Tuscan tragedies, that the dramatic art was known in Italy at a very early period; but we can no more judge of the progress of the art, in such distant times by this passage, than we can gather the history of the kings of Babylon by the fragments of Sancliangon. The Romans, while extending their arms over Italy, left to Etruria her drama and theatre such as it was. On one occasion, we are informed, that, during a pestilence at Rome, the Sybiline oracle predicted, that it could not be stopped without some stage-players being sent for from Etruria. The performers accordingly came; but as the pestilence did not subside, they were dismissed with discredit for having belied the oracles, while the oracles themselves were never blamed for their false prediction. Horace informs us, that in the repose and leisure which followed the Punic wars, the Romans began to study the tragic and comic poets of Greece, and made attempts to transfer their beauties in translation. This, in fact, was the origin of the drama at Rome; but when regard to the epoch, one is tempted to believe, that the text of Horace has been vitiated. The reign of genuine comedy at Rome appears to have been during, not after, the Punic wars, from Naevius to Terence and Afranius, about the space of a century. It was in this interval that Licius, Cecilius, Plautus, Lucilius, and Terpilus flourished. Terence died thirteen years before the destruction of Carthage. It was not then, as Horace has said, post Punica bella, that the Romans began to copy the Greeks. Of the only two whose works remain to us, Plautus and Terence, the one has copied Cratinus, and the other Menander. It has been said, that Plautus imitated Aristophanes, which is assuredly unfounded. An imitation of Aristophanes would not have been tolerated by a Roman audience. The genius of Roman manners, which communicated a decency and dignity to the lowest orders, would have revolted at such atrocious characters. The new comedy alone, that which contained no personal satire, was fit to be received among a people so proud and austere. There is some room, indeed to suspect, that Naevius, the first of the comic Latin poets, tried the experiment of personality; and it was probably on that account that he was chased out of Rome by the aristocratic faction. If so, his example was a caution to succeeding poets; for though it was permitted to comedy to represent all classes of society, from the lowest to those of consular rank, there is no appearance of its having dealt in individual abuse or allusion. The age of Augustus does not seem to have produced a single celebrated comic poet; and in the degeneracy of manners which succeeded to the loss of Roman liberty, the rage for pantomime destroyed all genuine relish for the drama. Plautus and Terence, we are told, borrowed from the Greeks. At the bare mention of imitation and borrowing, the haughty is apt to be much impressed in disfavour of the writer to which it is imputed. If we possessed not the works of Homer, and only heard in general, that Virgil was a copyist of the Grecian epic poet, we should not be able to give credit to the author of the Aeneid, for the spirit of beauty that breathes in his writings, independent of all obligations to the Aeneid. It is always to the disadvantage of an ingenious writer, who may be taxed with plagiarism, not to have his work confronted with his alleged model. This

* Casaubon in his treatise on the satirical poetry of the Greeks and Romans, has established a distinction between the satires of the two nations. Those of the Greeks were little pieces for the stage; those of the Romans were moral invective poems.
consideration should prevent our being swayed implicitly by the indefinite charge of plagiarism, attached to Plautus and Terence. The works of Cratinus and Menander, cannot now be consulted, to ascertain the extent of their debt; but the humour of Plautus, and the elegance of Terence, still remain to us, and if they were imitators, it must be owned that they were good ones. The comic vein of Plautus, it may be said, is coarse, monstrous, and limited in its range of characters. Yet it is from this Plautus, that modern comedy has borrowed some of its richest materials. His Miser, the original of Molière's Avare, has not been so entirely transmuted or recreated in the hands of the French dramatist, as the French critics would lead us to believe. His Twin Brothers is evidently the source of Shakespeare's Comedy of Errors, with the difference, that Shakespeare's plot is more improbable, and much less skilfully conducted.

With regard to Terence, he is said to have joined together several of the plots of Menander into one of his own; a circumstance which entitles us to suspect, as the plots of Terence are remarkably simple, that the originals must have been thin and deficient in action, and that he improved on them with considerable dramatic art. Comedy at Rome, ventured to delineate Roman manners. Tragedy was more timid. It attempted, indeed, sometimes to rise above its models. The subject of Iphigenia in Tauris was enriched by the genius of Pacuvius. It is to him that we owe that affecting scene of a combat of friendship, where Pylades wishes to die for Orestes; but although the tragedy of Rome borrowed something of her stateliness and heroic genius, it appears almost invariably to have attached itself to Greek subjects. It is known, that Andronicus was a mere translator, and the titles of the tragedies known to be written after him, betray the same origin, as the Orestes of Pacuvius, the Elidus of Accius, the Eclipsus of Julius Caesar, the Ajax of Cassius and of Octavius, the Thesmophoria of Gracchius and that of Varius, the Medea of Ovid, and the Theatre of Seneca.

From the Roman poets till the revival of modern learning, there is a blank of many ages in the history of the drama, as in that of all the other branches of literature. About the eighth century, Europe was principally carried on by means of fairs, which lasted several days. Charlemagne established many marts of this sort in France; as did William the Conqueror and his Norman successors in England. The merchants, who frequented these fairs in numerous caravans or companies, employed every art to draw the people together. They were therefore accompanied by jugglers, minstrels, and buffoons, who were no less interested in giving their attendance, and exerting all their skill on these occasions. As now but few large towns existed, no public spectacles or popular amusements were established; and as the sedentary pleasures of domestic life and private society were yet unknown, the fair time was the season for diversion. In proportion as these shows were attended and encouraged, they began to be set off with new decorations and improvements; and the arts of buffoonery being rendered still more attractive by extending their circle of performances, acquired an importance in the eyes of the people. By degrees the clergy observing that the entertainments of dancing, music, and mimicry, exhibited at these projected annual celebrations, made the people less religious, by promoting idleness and a love of festivity, proscribed these sports, and excommunicated the performers. But finding that no regard was paid to their censures, they changed their plan, and determined to take these recreations into their own hands. They turned actors themselves, and, instead of profane mummeries, presented stories taken either from legends or the Bible. This was the origin of that incongruous thing called sacred comedy. The death of St Catherine, acted by the monks of St Denis, rivalled the popularity of the professed players. Music was admitted into the churches, which served as theatres for the representation of holy entertainments. The festivals among the French, called Le fet de fax, de l'ane, du des, at length became greater favourites, as they certainly were more capricious and absurd than the interludes of the buffoons at the fairs. These are the ideas of a judicious French writer, given by Warton in his history of English poetry.

Voltaire's theory, Warton continues, on this subject, is also very ingenious, and quite new. Religious plays, he supposes, came originally from Constantinople, where the old Grecian stage continued to flourish in some degree; and the tragedies of Sophocles and Euripides were represented till the fourth century. About that period, Gregory Nazianzen, an archbishop, a poet, and one of the fathers of the church, banished pagan plays from the stage at Constantinople, and introduced select stories from the Old and New Testament. As the ancient Greek tragedy was a religious spectacle, a transition was made on the same plan, and the choruses were turned into Christian hymns. Gregory wrote many sacred dramas for this purpose, which have not survived those inimitable compositions. One, however, his tragedy called Xενεσίς παρεια, or Christ's Passion, is still extant. In the prologue, it is said to be in imitation of Euripides, and that this is the first time the Virgin Mary had been produced on the stage. The fashion of acting dramatic scenes, in which, at first, a due degree of gravity and solemnity was observed, but at length adopted from Constantinople by the Italians, who framed, in the depth of the dark ages, on this foundation, that barbarous species of theatrical representation called Mysteries, or Sacred Comedies, and which were soon afterwards received in France. This opinion will acquire probability, if we consider the early commercial intercourse between Italy and Constantinople; and although the Italians, at the time when they may be supposed to have imported plays of this nature, did not understand the Greek language, yet they could understand, and consequently could imitate, what they saw. In defence of Voltaire's hypothesis, it may be farther observed, that the Feast of Fools and of the Ass, with other religious farces of that sort, so common in Europe, originated at Constantinople. They were instituted, although perhaps under other names in the Greek church, by Theophylact, patriarch of Constantinople, probably with a better design than is imagined by the ecclesiastical annalists, that of wean...
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ing the minds of the people from the Pagan ceremonies, particularly the Bacchanalian and calendar ceremonies, by the substitution of Christian spectacles partaking of the same spirit of licentiousness. But a still earlier, and more curious, specimen of theatrical representation of sacred history, is mentioned by the historian of English poetry. Some fragments (he says) of an ancient Jewish play on the Exodus, or the departure of the Israelites from Egypt, are yet preserved in Greek fragments. The principal characters of this drama, are Moses, Sapphira, and God from the bush. Moses delivers the prologue, or introduction, in a speech of sixty lines, and his rod is turned into a serpent on the stage. The author of this piece was Ezekiel, a Jew, who was called Ὅ τὸν ἔκκαλον τραγωδίων παίδας, or the tragic poet of the Jews. Mr. Warton is of opinion, that Ezekiel composed this play in imitation of the Greek drama, at the close of the second century after the destruction of Jerusalem; and even in the time of Barocbas, as a political spectacle, with a view to animate his countrymen with hopes of a future deliverance and restoration. Boileau, in the subjoined verses, considers the ancient pilgrimages to have introduced those sacred mysteries into France.

Origin of the modern drama.

Ches nos devoue ayeux le theatre aborde.
Put long-tems dans la France une plaisir ignoré
De Pelerins, dit on, une troupe grossiere
En public, a Paris, y monta la première ;
Et, dormant sotre en la simplicité,
Jona les saints, la Vierge, et Dieu, par pieté.
Le savoir, a la fin, disant Ignorance,
Et voir, de ce projet, la devote imprudence;
On chasse ces docteurs prêchant sans mission,
On vnit renante Hector, Andromaque, Ilium.

The authority to which Boileau alludes is Mones- trier, an intelligent French antiquary. The pilgrims who returned from Jerusalem, St James of Compos- tella, St Beannus of Provence, and others, composed songs on their adventures, intermixing recitals of passages in the life of Christ, descriptions of his crucifixion, of miracles, and martyrdoms. To these tales, which were recommended by a pathetic chant, and a variety of gesticulations, the credulity of the multitude gave the name of visions. These pious itinerants travelled in companies, and taking their stations in the most public streets, and singing with their staves in their hands, and their lutes and mantles fantastically adorned with shells and emblems painted in various colours, formed a sort of theatrical spectacle. At length their performances excited the charity and compassion of some citizens of Paris, who erected a theatre, in which they might exhibit their religious stories with the addition of scenery and decorations. To these (continues the ingenious author already quoted) who are accustomed to contemplate the great picture of human follies which the unpolished ages of Europe hold up to our view, it will not appear surprising, that the people who were forbidden to read the events of the sacred history in the Bible, in which they were faithfully and beautifully related, should, at the same time, be permitted to see them represented on the stage; disgraced with the grossest improprieties-corrupted with inventions and additions of the most ridiculous kind-stilled with impurities, and expressed in the language and gesticulations of the lowest farce. On the whole, the mysteries appear to have originated among the ecclesiastics, and were, most probably, first acted, at least with any degree of form, by the monks. The play of St Catherine was performed by the monks at Dunstable Abbey, in the eleventh century, under the superintendence of Geoffroy, a Parisian ecclesiastic; and the exhibition of the Passion, by the mendicant friars of Coventry and other places.

From the end of the 11th to the verge of the 14th century, the troubadours were the pre-eminent poets of Europe; but it does not appear that they contributed directly, either to the formation of a regular theatre, or to the refinement of dramatic taste. The tragedies of Anselme Faydit, one of the principal poets of this class, are, however, mentioned as appearing early in the thirteenth century; and one of them, written about the year 1210, entitled Hervis de les Preures; the Hervis of Priests, is still extant. It is a violent satire against the Roman clergy. Faydit, it appears, was both an author and an actor. About the year 1280, the poet Parusols, another troubadour, composed Les cing belles tragedies des Gestes de Johanne Bayne de Naples. This Jane, queen of Naples, was a monster, who, at eighteen years of age, assassinated her husband, and who finished her career by being smothered between two mattresses. The troubadour, who celebrated her exploits and death, was her contemporary, and must have celebrated her crimes while she was yet living.

During the fourteenth century, the dramatic history of Europe presents nothing but sacred mysteries. The church itself might, indeed, be said to become a theatre; festivals were not merely celebrated, but represented. On the death of the three kings, (the festival after Christmas, still called Hogmanay in Scotland,) three priests, habited like kings, conducted by the figure of a star which appeared at the top of the church, went to a manger, and offered their gifts. The mysteries were, in all probability, for the most part acted with dumb show. To trace the first transition from these to the regular drama, or to ascertain which of the nations of Europe had the honour of first making that transition, is a task of extreme difficulty. It seems, however, upon the whole, most admissible, that Italy may first claim that distinction. In the age of Lorenzo de Medici, (says the elegant historian of that house,) those ill-judged representations (the mysteries) began to assume a more respectable form, and to be united with dialogue. One of the earliest examples of the sacred drama, is the Rappresentazione of St Giovanni and St Paolo, by Lorenzo de Medici. Cionacci conjectures, that this piece was written at the time of the marriage of Maddelena, one of the daughters of Lorenzo, to Francesco Cibo, nephew of Innocent VIII, and that it was performed by his own children; there being many passages which seem to be intended as precepts for such as are entrusted with the direction of a state, and which particularly point out the line of conduct which he and his ancestors had pursued, in obtaining and preserving their influence in Florence. The concluders of Lorenzo in this attempt to mollify the imperfect state of the drama, were Fco Belcari, Bernardo Pulei, and his wife Madonina Antonia de Tanini. That Lorenzo had it in contemplation to employ dramatic composition in other subjects, is also apparent. Among his poems, there is found an attempt to substitute the lives of the ancient histories, the saints and martyrs of the Christian church; but the jealous temper of the national religion seems, for a time, to have restrained the progress which might have been otherwise made in this important department of letters. After a faint dawn in the tragedies of Galietto, Antonio da Pistoia, and Bernardo Accolti, the rise of the Italian drama properly commences with Trissi-
This tragedy was represented in Rome 1515, in the presence of Leo X, to whom it was dedicated, and under whose auspices it was written; and, in the year 1562, when a wooden model of the famous Olympic theatre of Palladio was erected, for trial, in the Palazzo del Ragione, the Sophonisba of Trissino was selected for representation. The historians of Vincenza dwell with pride and pleasure on the splendid of this spectacle, and on the great concourse of nobility, from even the most distant parts of Lombardy, who assisted. This tragedy is written in verse sciolto; and the author, following the Greek model, conducts his plot with great simplicity; only interrupting the course of the action with the aedes, and occasional observations of a moralising character. Sophonisba was soon known beyond the Alps; and, according to Voltaire, it was from the Sophonisba of Trissino that the French learnt the dramatic rules. Encouraged by the success of Trissino, his contemporary and friend Giovanni Ruccelai, nephew of Lorenzo de' Medici, and cousin-german of Leo X, entered the dramatic career. In the year 1516, his Rosmunda was recited in his garden at Florence, in the presence of Leo. This tragedy is founded upon a story of strong interest in the history of the Lombards, which is related with simplicity and perspicuity in the Istoria Fiorentina of Machiavelli, and splendidly and minutely detailed in the luminous page of Gibbon. Mr Roscoe has observed, on this tragedy, that Ruccelai has preserved his heroine from the crimes of prostitution and assassination, and has introduced a disinterested lover in the person of Almcnilde, who executes vengeance on the king from generous and patriotic motives. In justice to the author, it must also be observed, that the horrid incident upon which the tragedy is founded, is narrated only, and not represented, before the audience.

The rest of the sixteenth century presents a list of tragic writers, many of whose works are spoken of in the highest terms by Graovina Riccoboni, and other critics of equal authority. Among these, Giambalista Geronembe is entitled to notice, for being the first who divided the Italian drama into acts and scenes, and making the prologue independent of the piece, which had formerly, according to the Aristotelian canon, formed an awkward integral part of it. Cinthio is memorable for having afforded, in his novels, many materials to Shakespeare. Tasso's Torrismonda ought not to be forgotten; nor Manfredo, the friend of Tasso, who anticipated the subject of Semiramis, afterwards adopted by Voltaire. In the course of the same century, the pastoral comedy became popular; which, whatever the enthusiastic votaries of Tasso and Guarini may say, introduced representations of life the most affected and unnatural, and must have contributed to denaturalize the tone of the rising drama. Riccoboni gives the following general character of the Italian tragedy of the sixteenth century: The tragedies composed from the year 1500 to 1600, or thereabouts, have been found to be too savage, and have not produced pleasure. In short, the horrible was pushed to such excess, that it disgusts the Italians. Poets were not contented to make sons kill their mothers, and fathers their children, but urns were brought upon the stage, from which the limbs of the massacred innocents were piece-meal produced before the spectators.

The 17th century may, with little injury to the dramatic reputation of Italy, be passed over in silence. The rage for the musical drama, which was kindled by some favourite productions of Count Fulvio Testi, Dr Burney, with all his enthusiasm for music, confesses to have been ruinous to true tragedy. The degeneracy of the Italian stage is, however, ascribed to a cause still deeper than partiality for music, by an eminent critic of that country, whose opinion is well entitled to notice. We allude to the Count de Calsibigi, who, in his letter to the celebrated Alfieri, ascribes it ultimately to the want of proper theatres. "Why," says that critic, "has no Italian author produced a tragedy which may be compared with the pieces of the Greek, or even of the French stage, since in every other branch we have poets without number? Why, as if despairing of recovery, have they returned back to those musical dramas, which having become ridiculous in the last century, have been since made more tolerable by Apelle Zeno, and afterwards perfected by Metastasio? Since the Sophonisba of Trissino, which was acted at Rome, and since some other tragedies (our first attempts in the art) represented at Florence and Ferrara, we have indeed never wanted poets, who have continued to write new pieces, and who have succeeded in producing them upon the stage. But what kind of stages were these? sometimes theatres belonging to the court, but most commonly to private noblemen, who caused them to be erected in their palaces and villas. Upon these temporary stages, select tragedies were represented a few times by the courtiers of the prince, or by private parties of ladies and gentlemen. Thus, Italy having never had a permanent tragic theatre, nor actors by profession, these private representations could only be called transient attempts, from which the art received little or no advantage. It was worse, (Calsibigi continues,) when those companies of actors, who have always reigned upon the Italian stage, got possession of those more or less imperfect tragedies, when they were made public by the press. Every body knows, (says he,) of what absurd and awkward buffoons these wandering troops are generally composed. Every body knows, that the greater part of these barbarous actors, besides being taken from the lowest and most uneducated part of the people, is born in those provinces where our language is spoken with the least purity, both in the grammar and in the pronunciation. Therefore, these actors lisping a tragedy, produce the same effect upon their hearers, as the tragedies of Racine or Voltaire would produce at Paris, if they were recited in the provincial brogue of Gascony or Picardy. We all know, to what ridiculous, ill-dressed, awkward, and even ugly females, the parts of the Phedra, Andromache, Semiramis, and Zara, are given to be torn in pieces in the jargon of Bologna, Lombardy, or Genoa; and to be recited or acted without elegance or grace, in the style of the beggar women in the streets. Thus the entire want of a permanent and well conducted theatre, and the more important deficiency of proper actors, hindered our poets from applying themselves to the composition of real tragedy, and prevented the studious and judicious part of the public from frequenting the theatre. Moreover, Italy being divided into so many small states, never has had a great and
central point of union for Italian ambition. The Romans, the Lombards, the Tuscans, the Piedmontese, the Venetians, and the Neapolitans, considered each other as having different interests, and as enemies, or at least rivals, both in the sciences and in the fine arts.

Here Calsigbi dilates on the baneful effects of the opposition in schools of painting, a subject on which we are incapable of appreciating the truth of his remarks; but language being a more conventional way of imitating nature, than by objects addressed immediately to the sight, and intelligible to all men, it must clearly be much more affected in its progress towards refinement than either painting or sculpture, by the provincial distractions of an unsettled style. "This is the reason, (he continues) that having no permanent theatre, whilst in many cities there was a musical stage, almost constantly we have returned to this latter, forming dramatic monsters; for such are the greatest part of our musical plays."

In spite of all these disadvantages, Italy again rose into dramatic lustre in the eighteenth century. Goldoni redeemed the genius of its comedy, if not entirely from farce, at least to comparative refinement from its former state. Metastasio infused poetry into the opera, and Maffei delineated in his Merope, some of the strongest workings of the human heart. Some pieces of considerable interest appeared from the time of Maffei to that of Alfieri; but, upon the whole, the tragic genius of the country, seemed to be again sinking into languor, when that latter extraordinary genius (Alfieri) appeared. In him, the tragic muse spoke a language fraught with an elevation of sentiment, and a strength of majesty, of which her dramatic pieces had formerly conveyed no trace. With classical simplicity of structure, he sought to unite a stern and austere grandeur of diction, wholly unlike the conceits and effeminacy which had so long possessed his native stage. The universal feelings of his countrymen seemed to sympathise with his regenerating efforts; and the burst of public applause which they excited, seemed to say, that Italy had still majestic sentiments of virtue, to which the portraiture of her sickly drama had not before done justice. Even the partiality of his countrymen, however, was not blind to the errors into which his genius fell, from a systematic and overstrained pursuit of peculiar excellencies. The regularity of his first tragedies, was felt to border upon stiffness; his austerity of sentiment, on harshness; and the purity of his diction, on boldness and abrupt compression. In avoiding the florid luxury of his national poetry, he over-affected the sombre energy of Dante. At a subsequent period, he adopted the scripture subject of Saul; and it appears upon the whole, by its grandeur and primitive simplicity, to have accorded well with the tone of his genius. Probably instructed by public opinion, he now gave his thoughts a more poetical dress; there is even occasionally in this piece an oriental pomp of expression. The subject is the frenzy and death of the Hebrew monarch; the characters which attach our sympathy by their dangers and Pourtrayed affections, are those of Jonathan, David, and his beloved Micah. The reader, without being hypercritical, will regret in this beautiful tragedy, that the knot of interest is not sufficiently distinct and visible. We have a general alarm and presentiment of danger, from the menacing insanity of Saul; but the events to be hoped for or feared, are somewhat too undefined, and the curiosity is rather passively than actively exercised. But still the tone of the piece is inspired and enchanting. The beauty of the friendly characters fixes our love; the madness of Saul is a thrilling and terrible picture; and the proud, fanatical enthusiasm of Achimelech, when he denounces the curse of heaven on the king for his slaughter of the priests, contrasted with the severe intrepidity of Samuel, furnish scenes of the most profound and electrifying effect. To enter on the whole drama of Alfieri, would far surpass our limits; we must content ourselves with remarking, that in Vincenzo Monti, who, we believe, is still alive, Italy possesses a highly promising tragic poet, who, in his tragedies of Galezzino, Manfredi, and Aristodemus, has evinced a spirit worthy of succeeding Alfieri, and who, in the charms of diction, is supposed even to surpass him. The revival of poetry at so late a period, may well encourage us to expect, that a people whose genius has ever shone so conspicuous in the other arts, will yet enrich the world of fancy with captivating productions of the drama.

Among the nations of modern Europe, Spain commenced her career in literature more independently of strangers than any other. Dramatic poetry, in particular, sprung up among them, before the subsequent extension of their empire gave them any connection with their neighbours, and forming itself on the ancient Castilian taste, after their own manners, and customs, and romantic fancies, it was much less regular than that of other nations; much less imbued with the sage spirit which united philosophy with enthusiasm among the Greeks; but it was much more calculated to move the native Spaniard; much more in harmony with his opinions and feelings; and much more calculated to hold of his national pride. Such was its impression, that neither the satires of other nations, nor the criticisms of their own literary men, nor the prizes of academies, nor the favour of princes, have ever been able to bring the Spaniards into the dramatic system which predominates in the rest of Europe. Italy boasts of Tasso, in the 16th century, as the author of the first regular tragedy of modern Europe. Without a claim to regularity, the Spaniards go back to the 15th century for the birth of their dramatic poetry. They ascribe its origin to three works of a kind very different from one another, viz. the mysteries of the churches; the satirical and pastoral drama, entitled Mingo Rebulo; and the dramatic romance of Calixtus and Meliboea, or Celestina. The mysteries, which constituted the ornaments of their religious solemnities, had an indisputable influence on the Spanish theatres; and the Autos Sacramentales of their most celebrated authors, are made almost on the model of those ancient holy farces. The work called Mingo Rebulo, composed before the middle of the 15th century, under the reign of John II. and which was meant to turn the monarch and his court into ridicule, is rather a political satire in dialogue, than a drama. But the Celestina has very different claims to the attention of those who are curious about the origin of the modern drama. Of this strange piece, the first act was written by one whose name is unknown, about the middle of the 15th century, at a time when the rest of Europe was applauding the profane drollery of the mysteries, and long before any other people of modern Europe had shown the slightest talent for the comic drama. The dialogue of Celestina has frequently spirit, wit, and gaiety; the characters are tolerably traced;
and the intrigue exposed with sufficient clearness; and the language of the lovers supported with warmth and sensibility. But the first anonymous author had left the action incomplete; he had only interested us in the love which the beautiful Melibea had cherished for Calixtus; had apprised us of the obstacles which their passion opposed to their union; and had introduced to Calixtus a sorceress named Celestina, who had engaged to assist him in his love. Fernand de Rojas continued this imperfect comedy about the year 1510, and prolonged it to twenty acts; a length which precluded its representation. He makes the personages pass through the most romantic adventures, and gives the drama a tragic denouement. Celestina introduces herself into the house of Melibea, corrupts her domestics, bewitches the young woman by her spells, and brings her to guilt. Scarcely is Melibea plunged in dishonour, than her relations avenge it. The different domestics who had been employed by Celestina perish by the sword or poison; she herself is poignarded, Calixtus is also killed, and Melibea throws herself from the top of a tower. Thus, romance succeeds to comedy, and the interest of fancy to that of curiosity. In spite of this, few works have been greater national favourites than this of Celestina, whose enthusiastic admirers in Spain, have considered it as the first lesson of morality ever exhibited by the drama. There were many Spaniards, however, who thought its tendency very different. To decide the controversy, the church was consulted. The issue of this appeal was, that in Spain it was prohibited, in Italy approved—and it should be noticed, that in point of time, we are speaking of a tragic-comedy begun in 1440, finished in 1510; begun sixty and finished five years before the appearance of Trissino's Sophonisba, and yet of sufficient importance to divide the public opinion of Europe, and to have Italy on the side of the debated play. This circumstance shows, that the popularity of Spanish literature was more early and important than is generally supposed.

Such was the state of the Spanish theatre, pleasantly described by Cervantes, when Lope de Rueda, whose comedies and acting the author of Don Quixote had admired in his youth, headed his strolling company. His theatrical wealth, says Cervantes, consisted in four white shepherd's dresses, garnished with gilt feather, four beards and trains of false hair, and four crooks, more or less. The comedies were only conversations, like eclogues, between two or three shepherds and a shepherdess, which were embellished and prolonged by two or three interludes of Negresses, clowns, and Biscayans. Naharro, (says Cervantes,) a native of Toledo, succeeded to Lope de Rueda in celebrity as a comic actor and author. He made some small addition to the decorations of his native theatre, and changed the sack which had conveyed its moveables into boxes. He brought forward the music, which had been kept behind the curtain, in front of the scene, and took away the false and artificial beards from the performers, except from those who played the characters of old men. He was also the author of comedies, and light farces and battles, by artificial means on the stage. But nothing of this kind, Cervantes adds, was brought to perfection, until his own plays were performed; and he boasts of being the first who exhibited moral and allegorical figures in the Spanish theatre, as well as of reducing the representation from five to three acts. In this latter circumstance, however, Cervantes appears to have been ignorant, that Torres Naharro had anticipated him. The name of Cervantes himself forms an interesting epoch in the Spanish drama. He composed, he tells us, from twenty to thirty comedies. (The word comedy was at this time applied, in a very strange manner, to productions fraught with representations of the terrible and pathetic.)

—Lope de Vega possessed a lively and magic volubility, for rendering absurdity itself entertaining. Cervantes was no more than his great contemporary, seriously disposed to give a classical harmony of design to the Spanish drama. They both of them laughed at their own inferiority to the ancients, and Lope even speaks of his preparing himself for the composition, by putting the ancient authors out of his study, lest they should chill him by their condemnation; but both he and Cervantes were probably, in their own predilection, as much disposed to the fantastic drama, as their audience were exclusively disposed to receive it. Lope succeeded, and Cervantes, we find, was comparatively unfortunate. No great weight needs to be attached to the decision of their contemporaries, if we consider a tasteless and barbarous age as standing upreight between them. But whatever the genius of the Spanish drama might be, Lope de Vega contrived to make it popular, while the nervous precision of thought, and the solid talent of Cervantes, seems to have been ill calculated to deal with its mass of intrigues and adventures. His comedies are therefore, in general, (and it would seem with great justice) accused of being cold and fatiguing; and in the dispute between this great man and the contemporary public, respecting the degree of his dramatic genius, the public opinion, which rated it lower than he did himself, appears in this, as in most cases of the same kind, to be right.†

There is nevertheless one of his early pieces, written before his rivalry with Lope de Vega began, which may well qualify any general decision against his talents for the drama;—this is his tragedy on the siege of Numantia. It is altogether a distracting medley

* It was probably owing to this want of a regular theatre in Spain, that the pieces of Torres, a comic poet anterior to Lope de Rueda, and who, though not mentioned by Cervantes, was really the father of Spanish comedy, never were acted in his native country; at least there is no proof that they were acted, although to Bouterwek they were printed as early as 1533. Torres Naharro is also supposed to be the first who divided Spanish comedy into three acts or jornadas. It does not even appear that Torres Naharro's pieces were ever popular, for they were immediately forgotten in the reputation of those prose comedies of Lope de Rueda, which Cervantes speaks of having seen in his youth. Torres Naharro is to be distinguished from another Naharro, who is mentioned by Cervantes as the successor of Rueda in reputation for comic compositions and acting. Without finding it possible to enter individually into the merits of those who commenced the career of the Spanish drama, it would be injustice, even in the shortest sketch, to omit the name of Gerónimo Bermúdez. This writer was a Dominican of Galicia, who was so diffident, that he would not venture to publish at first, but under a feigned name. He is the author of two tragedies on the subject of Inez de Castro; one of which contains some passages highly tragic and elevated. Taken altogether, his tragic poetry is poor and imperfect; but his taste is entitled to respect for the attempt which he made to give a classical turn, and an elevated tone of diction, to the language of tragedy; an example on which so few dramatic writers of his country thought fit to improve. Had there been but one or two men of genius to follow the hint of Bermúdez, the Spanish stage would not have been disgraced by the wild extravagance of its general character. This old Dominican, as his genius was, saw with the eye of taste, that while the classical form of tragedy was desirable, the accidental, the subjects of modern interest were fitted for a modern stage. He chose, therefore, the subject of the unfortunate Inez de Castro, which Camoens has made poetically memorable, by embodying it in the Lusíad; but Gerónimo Bermúdez wrote before the Lusíad had appeared.

† It is generally allowed, however, that the interludes, or short comedies of Cervantes, possess considerable merit.
of great absurdities; and at the same time of sublime and impressive traits of imagination. To uphold it altogether as a good or a great tragedy, is impossible; but it is equally impossible to deny, that it must remind every reader of Æschylus, of those gigantic traits of terror, which distinguish the father of Greek tragedy. It fairly challenges a comparison with Æschylus's Persians, or the Seven Chiefs of Thebes, in the boldness of its pictures, and grandeur of execution, and justifies what an able critic has said, that its author, in more favourable circumstances, would have become the Æschylus of Spain. As Cervantes found but a very few facts in the historians who relate the destruction of Numantia, he was obliged to invent most of the incidents of the piece. His object was to unite the marvellous and pathetic; and though the story of a siege, in which the inhabitants determined at last to destroy themselves, and to perish in the flaming ruins of the place, rather than submit, is not what we should consider, in the present day, as a subject best fitted for dramatic effect: yet the mind cannot but sympathise with the zeal and patriotism which a poet must have felt in endeavouring to record such terrific grandeur in the national character. The scene opens with the Roman camp, which is before Numantia. Æsculapius appears with his principal officers, and addresses his soldiers, to reprimand them for their sloth and luxury, which has delayed the conclusion of the siege. The address, though long, is full of Roman and soldier-like eloquence. In this scene, the novelty of the dramatic art is pleasantly developed in the notes of direction which the author gives to his actors. Here there shall enter as many soldiers as can be brought upon the stage, and Cainis Marius with them; they shall be armed in the ancient manner, without firelocks; and Scipio, mounted upon a small rock, which shall be upon the stage, shall look at his soldiers before addressing them. Numantian ambassadors arrive with offers of peace, which Scipio rejects. Spain is then personified, and appears upon the stage as a female, crowned with towers, and bearing a castle in her hand, in allusion to the name of Castile. She calls for the rivers Duero, or Durius, on the banks of which Numantia was situated; and Duero presents himself, accompanied by three tributary streams. These allegories may make us smile, while they remind us of the appearance of the Thames, in Sheridan's critique, between two attendants, representing his banks, with willows in their hands.—But we should also recollect, that if classical example can palliate the circumstance, Euripides has his character of Xanthus, or death, a principal agent in the drama of Alcestes, not to mention the allegorical personages whom Æschylus brings to light—Prometheus. After Spain and the river gods have consulted about the fate of the city, the scene changes, and transports us to Numantia;—the senate is assembled, and deliberates on the common danger. In the second act, a commencing interest is created in the character of a young Numantian, Morandro, the lover of Lira; and a story of individual and tender passion is therefore interwoven with the history of the siege. A scene of public sacrifice ensues, in which the terrors of the people are aggravated by unfavourable omens; the torches will not kindle their fire, and the thunder sounds an evil presage, in answer to the sacred invocations. (Here another note of the author directs the actors to imitate thunder, by hurling under the stage a tumbrel, or vessel full of stones.) At last the victim is snatched from the sacrifice by an infernal spirit. So much of the effect of such scenes depends on execution, that it is difficult to say how much of the ludicrous or of the terrible might predominate, according to circumstances, in their representation. —But a scene ensues, in which, though there is some degree of the horrible, there is also so much intrinsic terror, that we might conceive it to be highly effective, even with ordinary apparatus. —This is, when the sacrifice having failed, recourse is had to a magician, who is gifted by his enchantments to predict the will of heaven. He approaches the tomb of one who had recently died of famine, and invokes the spirit from the realms of death. His address to the infernal powers is highly poetical. He speaks to the demons in that tone of command, and even with that wrathful disdain, which fiction ascribes to the magicians that are the masters, not the subjects, of infernal influence.—The tomb opens—the body arises, but at first motionless and dead, till the magician forces it, by new enchantments, to assume animation and speech. The corpse then announces that Numantia shall not be conquered; but that it shall not be victorious; and that all its citizens shall perish by the sword upon one another;—it falls back again into the tomb, and the magician, in despair, plunges a weapon into his own breast, and buries himself in the same tomb. After the return of a second embassy, as fruitless as the first, the Numantians take up the resolution with which their heroic senator Theogenes inspires them, to burn with the pomp of a sacrifice all their precious effects—to put to death their women and children, and, lastly, to throw themselves into the funeral pile of ruin, that not one may survive to be a slave of the Romans. From the moment that this is determined, the author crowds together, till the conclusion, the deepest scenes of grief, and the most sublime traits of patriotism. Famine desolates the city. —The young lover and hero, Morandro, already mentioned, accompanied by a friend, penetrates into the Roman camp—he returns mortally wounded, but in possession of a piece of bread, which he has ravished, at the price of his life, from the enemy, in order to bring to his mistress Lira. He tells her, that the blood which stains the bread is his own, and expires at her feet, as he bequeaths the sad and bitter nourishment.

Pero mi sangre vertida
Y con esto pan devorado,
Je ha de dar, mi dote amada,
Triste et amarga comida.

The action supports itself with the same interest to the end of the piece, when Fame proclaims its conclusion from the ruins of Numantia, and predicts the future glory of Spain.

Lope Felix de Vega Corpio, was 15 years younger than Cervantes, being born in 1502. This prodigy of Vega's fertile talent, if he did not create the Spanish drama, at least unchangeably fixed its general character and form. So much did he establish the character of his native stage, for a century and a half to come, that to give an idea of his works, is, in some degree, to give an account of the subdivisions of the Spanish drama, and the character of each subdivision. The word comedy (comedía) in the language of the Spanish theatre, means something very different from what was so called by the Greeks and Romans, or what it still signifies over the greater part of Europe. It is a general name, comprehending several different kinds of dramatic composition, each of which is really neither tragedies nor comedies. The principle of the ancient comedy, and
of the modern comedy, properly so called, is deeply connected with moral satire. In the Spanish comedy, satire is purely accessory and contingent. The portraiture of character is essential to the regular comedy of the rest of polished Europe; but it is not essential to that of Spain. The object is incident, intrigue, and surprise; a hardy and careless pursuit of the imagination, after such a change of scenes, interspersing the pathetic and burlesque, the trivial and the marvellous, as may keep the attention busy, curious, and astonished. Such a state of mind is obviously inconsistent with the pleasure arising from what we call comedy; in which the draught of manners is perhaps the first requisite, and wit and satire the second. But an interesting exhibition of manners requires a clear probability of incident; and the enjoyment of moral satire requires, not a hurried and tumultuous, but a well connected and consistent flow of events; leaving the mind room to reflect on the past, as well as to conjecture respecting the future.

Since the time of Lope de Vega, it has been usual to distinguish the pieces of the Spanish theatre into two great classes,—comedies sacred or spiritual, and comedies profane, or belonging to human life. (Comedias divinas et humanas.) It is usual to divide this latter class of human-life comedies, into those which are called heroic, and those denominated the comedies of the cloak and sword, (Comedias de Capa y Espada.) The heroic comedies were in their origin confounded with those of history; and the name of heroic was extended to those founded on mythological subjects. Those comedies of the cloak and sword were also called Comedias de Figaro, because the principal personages of these pieces is generally a knight of industry, who gives himself out for a great lord, or a fine lady, who makes similar pretensions. The spiritual comedies have been also subdivided, since the time of Lope de Vega, into dramas drawn from the lives of the saints, (Vidas de Santos,) and into pieces of the holy sacrament, (Autos Sacramentales;) the former have been formed upon the model of pieces called lives of the saints, which used to be represented in the monasteries. The Autos Sacramentales seem to have arisen in the time of Lope de Vega. Finally, we must add to those different kinds of Spanish comedy, the interludes which are played between the prologue and the piece, and which used to be called Sigmeter, until they were mixed with dancing and music. The historical or heroic comedies of Lope de Vega are very numerous. The tragic scenes which were incorporated in those wild compositions, were adapted to the Spaniards for the want of real tragedies. Very few of those heroic dramas of Lope de Vega are drawn from foreign histories. His Gera de Don Quijote is of this small number. There is little difference of character in the vast variety which he produced. The unity of action is only apparent; and as to unity of place and time, Lope de Vega never thought of them. The style is as capricious as possible, sometimes extremely elegant, but falling again into laxness and common-place. To give some idea of those pieces, we shall give a very abridged extract of one of the best, which is called "The Fortress of Toro," Las Almejías de Toro. The subject is, the assassination of the King De Sancho, by Bellido a knight, whom the king had offended by breaking his word to him. The same subject has furnished the subject of several old romances. In this, as in these old romances, the Cid Ray Diaz plays an important part. The Cid, the Cid, and the Count Azares, appear first upon the scene, which represents a plain at the foot of the strong city of Toro, in the kingdom of Leon. The king declares to the two knights, that political reasons do not permit him to respect the testament of his father; and that he cannot leave his two sisters, Elvira and Urra, in possession of the two strong cities of Zamora and Toro. The Cid, with a generous liberty, represents to the King the injustice of his enterprise, and offers his mediation with Elvira. The King and the Count Azares withdraw, and the Cid approaches to the walls of the fortress. He meets the Chevalier Ordonez, who had stolen out of the city with the design of rendering some service to the Princess Elvira. The two knights at first prepare for battle; but, at the name of the Cid, Ordonez kisses his sword, and they both embrace. The Cid here shows himself in all the greatness of his character. The Infanta comes to speak to him from the top of the walls, and explains to him the reasons that have obliged her to shut the gates of the city against her brother. The King returns, and orders an assault to be made on the fortress. The scene changes. Don Vela, an ancient cavalier retired from the world, walks in front of his country-house, and makes a soliloquy. His daughter, who is young and beautiful, enters on the stage singing, and surrounded by a troop of villagers. With this scene commences the episode, or underplot of the piece, of which Don Vela is a Prince of Burgundy disguised as a peasant, and in love with Sandea, the daughter of Don Vela. The scene again changes to the walls of Toro. Negotiations are set on foot between the parties, and the King has an interview with his sister. The conversion, which is pretty well seasoned with abuse, and in which there is a great deal of quibbling on the double meaning of Toro, which signifies both a bull and the city besieged, produces no reconciliation. A second assault is made, and is repelled, which closes the first act. In the second act, the underplot of the disguised Prince of Burgundy begins to have some connection with the main action. The Prince, and the beautiful Sandea, mutually breathe their tenderness in sonnets. Don Bellido next appears. He promises the king to make him master of the fortress, if he will agree as a recompense to give him the hand of the Princess Elvira. The King promises this, and Don Bellido, by the basest act of treachery, puts him in possession of the fortress; but the king conceives himself justified in breaking his word with a traitor, and refuses him his sister. This unfortunate Princess escapes in the habit of a female peasant. She finds an asylum in the family of Don Vela; and the piece continues in this manner to alternate tender and heroic, domestic and rural scenes, till its denouement, which consists in the King being assassinated by Bellido, and the Infanta brought back in triumph to Toro. The piece concludes with the marriage of the beautiful Sandea to her Prince of Burgundy, and with the union of the Infanta to the traitor Bellido, who had assassinated her brother.

The comedies of the cloak and sword, or the comedies of intrigue of Lope de Vega, are not, it is true, plays of character, but they present pictures of manners drawn after the life, however romantic. Their style, though in verse, has the same inequality, and the general character of their plots is the same with that of the heroic ones. The scenes succeed each other, without the connection of cause or probable motives. All the writer's object is intrigue; and frequently the plot gets so intricate, that the poet is obliged to cut the knot of interest, which he cannot unclose. The plays of our author are generally strewed with reflections and maxims of prudence; but, Lope de Vega's comedies of the cloak and sword.
he would have thought himself abridging his own dramatic liberty, if he had introduced morality properly so called. He has wished to draw the manners of his countrymen such as he saw them, not such as they ought to have been, and he has left it to the spectators to draw a moral for themselves. The most licentious spirit of gallantry, coloured by a sort of decency, and feebly restrained by honour, but never by a sense of duty, constitutes the essence of his comedies. If the poet exhibits lively passions, they rush to their gratification with a vehemence truly Spanish; if he paints the sober and sentimental affections, they are breathed with inexhaustible tediousness, and conveyed in language full of quibble and affectation. That love excuses everything, was then the favourite maxim of good company in Spain, and the personsage of Lope de Vega, ladies as well as gentlemen, act quite conformably to the maxim. Treasons and rascalitys the most detestable are introduced as things of course, and murder is by no means rare. On the slightest occasion, men of rank draw their swords, and, if one or other is killed, it is hardly spoken of. In this species of his pieces, it is however confessed, that there reigns a great deal of the natural, and that its expression never injures his poetical colouring. Of this description of his pieces, the Widow of Valencia (La Viuda de Valencia) forms an unfavourable example, as the plot is well supported, and as it has the rare merit of unity of action. The scene is laid at Valencia in the time of the carnival. Leonarda, a young, beautiful, and rich widow, but very capricious, has formed the resolution of never marrying again. She comes on the stage with a book in her hand, and tells us, that though she is neither a devotee nor a bel esprit, she reads for her amusement both profane and devout books, and that she desigs not to honour with a look the swarm of adorers who persecute her. After a great many spirited and sage remarks, which the widow makes on the vanity of admiration, her righous waiting-woman contrives to make her conclude them before a mirror, and in this situation she is found to her great mortification by her uncle. The old gentleman, however, consoles her, by proving the utility of looking-glasses, and advises her to a second marriage. In reply to which, she expatiates on the consequences of rash engagements, and with great pleasantry draws the picture of a man of fashion of Madrid in the 16th century. The uncle leaves her, and the scene changes. Three of the lovely widow's admirers present themselves before her gates, and each of them expresses, in a sonnet of one prolonged metaphor, their secret wishes and hopes. As they have no occasion to congratulate each other on the kindness of their mistress, they make a common confidence, and each relates a burlesque adventure, which had happened to him that night before the mansion of Leonarda. Leonarda, however, returns from the church in great haste, for she had seen a young man for whom she had conceived a passion, which altered her views about marriage. She wishes to bring him to her house, but resolves that he shall be ignorant whose it is. Her coachman Urbano, who is also the gracioso or buffoon of the piece, is charged with this commission. He goes off to fill it, and in the meantime the three lovers arrive masked, but without design, in the same manner. They are disguised as hawkers of books and prints. Their reception and dismissal by Leonarda has considerable gaiety. In the second act, the favourite youth Camillus makes his appearance, and hesitates for a long time whether to hazard the adventure which is proposed to him. Urbano draws a doctor's cap (capriote) over his eyes, and brings him thus, after a great many windings and turnings, to the apartment of Leonarda. She is masked. A magnificent collation is served up, of which the young man scarcely dares to taste, in his fears for the possible consequences of his adventure; whilst he compares himself to Alexander about to swallow the suspected beverage from his physician. After a tender interview, the doctor's cap is replaced over his eyes, and he is taken home. Several days are supposed to be passed over in one scene after another, in the course of which the decency of the widow's conduct is far from being ir reproachable. At length, after many singular changes and incidents, chance unravels the plot, after the author, as a passing amusement, has made a fair and honourable lover of the widow to be killed by the sword. Camillus finds the fair unknown one to be a beauty whom he had long admired, and is very happy to become her husband.

The spiritual comedies of Lope de Vega, pourray the religion of his times as faithfully as his comedies of intrigue point its manners. A true piety in the old Catholic sense, strangely founded in the most absurd chimeras; but chimeras often, ennobled by the genius of a bold and strong poetry, presents us with a creation unlike any other species of composition. The mixture of poetry, however, is very different in different pieces of this theological drama. Those, of which the subject is taken from the lives of the saints, have much more poetry than the comedies of the holy sacrament. Both of them were represented with great pomp, machinery, and music; in fact, with all the apparatus of the genuine opera. Of all his pieces, his Lives of the Saints are the most irregular. In these are introduced promiscuously, buffoons, saints, allegorical personages, peasants, kings, students, the infant Jesus, the eternal Father, the devil, and all that heterogeneous fancy could bring together. In the comedy of St Nicholas of Tolentino, (a modern saint, whom Lope has made the hero of one of his spiritual pieces,) the scene opens by a conversation of students, who emulously bring forward their wit, and scholastic erudition. Among these theologians, is the future saint; and his piety shines greatly in this society, which is a little profane. The devil, who is prudently masked, mixes himself with the comedy. A skeleton appears in the air. The heavens open, and the eternal Father is seen seated on his tribunal between Justice and Mercy, who alternately make their remonstrances to him. To this scene another succeeds, which makes us acquainted with a love intrigue between a Dame Rosalie and a Don Feniso. The saint again appears, and makes a sermon in Redondela verses. Having already become a canon, his parents testify their joy at having such a son; and thus ends the first act. In the second act, the saint prays in the shape of a sonnet; the heavens are opened, and he is taken up thither by the power of faith. He reappears, however, and the devil comes to tempt him. A little afterwards, there is a view of purgatory, and the souls which are roasting therein. The devil returns with a number of serpents, lions, and other frightful animals; but a religious person of the convent chases him off with a huge besom, in a scene which the author purposely makes burlesque (graciosamente.)

The autos, or comedies of the holy sacrament, were sufficiently absurd, but more simple and serious; in texture, more full of theological discussion, and so full of allegory and divinity, that it is difficult to conceive their having been intelligible to the common people: But the prologues and the interludes (Extremeses y synynter) appear to have been intended as
a compensation to the mob for the dullness of the autos. The intermedes are burlesque from beginning to end. This description of farces, taken entirely from the sphere of common life, was so popular in Spain, that no piece could be brought on the stage without one of them to recommend it. To sum up the dramatic character of Lope de Vega, we shall only quote the words of Lord Holland from his life of the poet. "The most temperate critics, while they acknowledge his defects, pay a just tribute of admiration to the fertility of his invention, the happiness of his expressions, and the purity of his diction. All agree that his genius reflects honour on his country, though some may be disposed to question the influence of his works on the taste and literature of their nation. Indeed, his careless and easy mode of writing made as many poets as poems. He so familiarised his countrymen with the mechanism of verse, he supplied them with such a store of common-place images and epithets, he coined such a variety of convenient expressions, that the very facility of versification seems to have prevented the effusions of genius, and the redundancy of poetical phrases to have superseded all originality of language. But the effect of Lope's labours must not be considered by a reference to language alone. For the general interest of dramatic productions, for the variety and spirit of the dialogue, as well as for some particular plays, all modern theatres, are indebted to him. Perfection in any art is only to be attained by successive improvement; and though the last polish often effaces the marks of the preceding workman, his skill was not less necessary to the accomplishment of the work, than the hand of his more celebrated successor. Had Lope never written, the master-pieces of Corneille and Moliere might never have been produced; and were not these celebrated compositions known, he might still be regarded as one of the best dramatic authors of Europe." Life of Lope de Vega, p. 229. et seq.

Pedro Calderon.

The name of Pedro Calderon forms the next great epoch in the history of the Spanish drama. His countrymen generally consider him as the sovereign genius of their stage; and some German critics have attempted to place him at the head of all modern dramatists. The number of tragedies, comedies, and farces, which he composed, has been differently estimated; but all accounts agree in representing them as exceedingly numerous. A most eloquent elogio on this writer has been given by the celebrated Mr Schlegel, a part of which has appeared in the last work of Madame de Stael. Even those who go not so far as Mr Schlegel in idolizing his genius, seem to agree to his general superiority over Lope de Vega himself, in combination of plot, in imbroglios, and in the invention of interesting situations. The palmer of fiction invention seems to be universally accorded to him; and with art and taste, whether in plan, execution, or style, it may be said that he created a new species of comedy. An air of delicacy and dignity breathes in his heroic pieces a higher strain of sentiment; and though the Spanish stage is, from its rapid intrigue, unsuited to the display of character, yet amidst the complexity and whirl of its action, he is allowed to produce traits of character which frequently give a deep insight into the hearts of his personages. A lively and bewitching dialogue, a delicious versification, and a subtilety almost inconceivable, in the nature of his plots, are the merits which his admirers challenge for him, above all other poets of the modern world. This merit of ingenious contrivance of plot, is indeed with him, and the most of Spanish writers, carried to a degree which a northern temperment has not curiosity to follow. The interest which many Spanish plots excite, is so labyrinthical, that the comprehension of them becomes a fatigue. But in this case, we must consider a poet as addressing himself to his countrymen; and the mind of a Spaniard, whether from an idler life, that gives him more practice in aerial castle-building, or from an imagination constitutionally more ardent, which invigorates his memory, has an easy delight in pursuing a dramatic story, which, to an Englishman or a Frenchman, would be wholly unintelligible. We are told by a credible traveller, that all Spaniards, without distinction, are so expert in following the thread of a plot, in its subtlest ramifications, that a common spectator, after having seen a piece performed, will repeat to you its whole contents in detail, while an intelligent stranger, the most familiarly acquainted with their language, can scarcely connect in his comprehension a few of the scenes. It is confessed, however, by judges, who, if they are far inferior to Mr Schlegel in the eloquence of enthusiasm, are no less intimately acquainted with the extensive drama of Calderon, (in itself the study of half a lifetime), that though he has the greatest talent in accumulating surprises, in linking together the most interesting situations, and in keeping curiosity alive, he is even less careful than Lope himself to connect his scenes with probability, or in giving motives and necessity to the entrance and exits of his personages. Even while the harmony of versification is admitted, sufficient proofs have been extracted by the critics, who have viewed him less favourably, that his finest pieces abound with monstrous deprivations of style, to which the conceits of the Italians is comparative simplicity. Calderon lived at the miserable epoch of Philip IV., and in his works there often breathes a ferocity of religious fanaticism which is truly horrible. One of his pieces is entitled "The Devotion of the Cross." The object of it was, to convince all Christian spectators, that devotion for the standard of the church suffices to atone for all crimes, and to insure the protection of God. "The hero is an artist, a blighter, an assassin by profession, but who raises the cross as an expiation for all his atrocities, on the tombs of each of his victims. The heroine, Julia, who is at once his sister and his mistress, more abandoned and more ferocious, if possible, than himself, participates in the same devotion for the sacred sign. He is finally killed in a conflict which he maintains against the troops of his own father; but he is raised from the dead, that a religious saint may hear his confession, and also assure his reception into heaven. His sister, when on the point of being taken, and made a victim to her enormities, embraces a cross which she finds before her, and makes a vow to return to a convent, and mourn for her transgressions. This cross immediately raises her up in the air, and carries her away, far from his enemies, to an impenetrable asylum. By those who have compared his voluminous pieces, that of his tragedy of Don Fernand is said to be the one in which he has put forth the greatest power of his genius. The Spanish title is "El Principe Constante." The unities of time and place are not observed; and, what is still worse, the unity of action, though preserved to a certain length, is ultimately violated. But as far as that unity goes, the story is greatly interesting and affecting. Don Fernand, Prince of Portugal, makes a descent upon the coast of Africa, accompanied by his brother Don Henry. He attacks the states of the King of Morocco, and is conqueror in the first battle, in
which an African hero. Muley, is made prisoner. This
Muley, who is in love with the daughter of the King
of Morocco, relates his history to the Prince of Portu-
gal; and Fernand, whose generosity is moved by the
recait, sets his captive at liberty. Scarcely has Muley
had time to express his surprise and his gratitude,
when reinforcements arriving to the Moorish army, a
second battle ensues, in which Fernand is defeated,
and in his turn taken prisoner. Here commences the
tragic interest, which is prepared by touching situa-
tions of a gentler description. The King of Morocco
offers liberty to his prisoner in exchange for the for-
tress of Ceuta, which the Portuguese possessed upon
his coasts. But the Prince declares that he will rather
in the cruellest slavery, than see a Christian deliv-
ered for his sake into the power of the infidels.
The Moorish sovereign sends an embassy to Portugal to re-
new the offer, which he thought the subjects of Fer-
nand could not refuse. They agree, indeed, to it, but
the heroic Prince still refuses his liberty on such terms.
Enraged at this refusal, the infidels aggravate his mis-
series, and subject him to the torture; but his constan-
cy is proof against them all. In the mean time, the
heart of Muley is bursting with agony at beholding the
sufferings of his former deliverer. The Moorish Prin-
cess, who returns Muley’s love, is also deeply interest-
ed in behalf of the Christian Prince. They plead in
vain for him; and a deeper shade of melancholy in-
terest is spread over this unfortunate pair in being torn
from each other. Their history, it is true, is in some
degree episodical, and independent of Fernand’s his-
tory; but still it is chained to it by an unity which
the mind forms to itself in considering them as the only
friends of the hero in a barbarous foreign country.
Fernand dies an unyielding martyr—the Regulus of
his country. And here, it must be confessed, the uni-
ty of action ceases; but the story is prolonged by the
arrival of a fresh army from Portugal. The scene of
it should be posthumous and disjointed, however
in itself imposing. It is the dead of night—military
music is heard at a distance—it approaches, and the
ghost of the martyr arrives with a torch in his hand,
and appears conducting the Christian troops against
the walls of Fez. Don Alphonso, the living leader of
the ‘warriors of Portugal, calls the King of Morocco to a
parley, tells him that he has killed his daughter Pheni-
cia, and her lover, the generous Muley, himself.
A treaty is concluded, by which the corpse of Fernand
is restored in return for the Moorish Princess and Mu-
ley; and the Christians obtain as a stipulation, that
they shall be suffered to marry her as a reward for their
common affection towards the dead Fernand.

Amidst those great names which constitute epochs in
the Spanish drama, we have forborne to speak of sev-
everal intermediate writers, who, although generally their
imitators, might probably, in some instance, improve
upon their models; but to give a list of all the drama-
tic writers of this theatre, would be to encroach too se-
iously on the boundaries of any Encyclopaedia. Among
the writers of the genuine Spanish school, who suc-
cceeded Calderon, are Antonio de Solis, and Augustia
Moreto. The former has paid great attention to give va-
riety to his comic characters, a circumstance in which
Calderon himself was deficient—, the latter is really the
most truly comic of all Spanish writers. Many others
might be mentioned, as Juan de Hoz, Tisso de Mol-
a, and the Chevalier Francisco de Rojas, or Rosas,
and Guillen de Castro, from whose pieces it is to be
hoped that a selection will yet be formed, sufficient-
ly worthy of the national honour; for in the editions
of the Spanish poets, the fault has been to make collec-
tions, of which many pieces are falsely attributed to
great names, instead of making selections of what is
intrinsically valuable. The facility of style in which
Lope de Vega and the primitive authoresses indulged, is
justly remarked by Lord Holland to have, in all prob-
ability, given rise to the revolution in taste and style,
which took place in the latter part of the century.
This revolution consisted in passing from the extremes
of licence, and simple carelessness, to that manner of
artificial bombast which is, in Spanish literature, called
Gongarism, from the author Gongora, who first brought
it into fashion.

This obscure and inflated school of writers seems,
however, at no time to have had possession of the
stage. Another revolution was approaching at the
commencement of the eighteenth century, which, for
a time, was scarcely less fatal. This was the influ-
ence of French taste, which, in the age of Louis XIV.
was extended all over Europe. Even in the 18th century,
it is true Spain has to boast of the names of Candomo
La Mora, and Canizares, who were the last of the school
of Calderon. But the influence of a foreign taste began to be sensibly felt when Luzan
published his Art of Poetry; and while he allowed no in-
considerable portion of genius to the great dramatic
names of his country, yet measured their merits so
strictly by the code of Aristotle and Horace, that he
left them, as far as his cold verdict extended, only the
shadow of their fame. When we express ourselves
with this apparent partiality for the old Spanish drama
which was thus attacked, we wish by no means to be
understood to be its implicit advocates. It is only from
a conception that the critical code of one nation is not
to be coldly or rashly applied to the poetical practice of
another. The French writers have a system of beau-
ties in their style and execution, which cannot be made
a standard without abundant qualification to the poe-
try of any people but themselves; and it would be
equally absurd to demand, in a French tragedy, the
same romantic traits which a Spanish tragedy possesses,
or to expect, in the works of Lope de Vega or of Cal-
deron, the entire regularity of Racine or Voltaire.
With regard to Luzan the critic, (a poet who was the
apostle of the Gallician taste), his system of poetical
criticism is in its essence and principles utterly cold
and bad. He was a pedant in the strict spirit and sense
of the word; and while he maintained that the natu-
ral, the useful or moral, and the elegant, were the fun-
damental principles of poetry, he was totally blind to
irregular inspiration of genius, so often displayed by
his countrymen, in which the beautiful rises above ele-
gance and correctness, and in which morality and senti-
ment, however noble and true, is not to be submitted
to the frigid rules of logical calculation. For half a
century, more or less, the Spaniards submitted to hear
their ancient and once boasted authors criticised with
indignity, till at last the plays written, or pretended
were to be written, on the system of French elegance, though
the true spirit of French tragedy was in reality far from
them, cured the nation of this predilection more effec-
tually than any critical dissertations of this taste for
taste correctness and Gallicism.

About the commencement of the latter part of the
18th century, Vincent Garcia de la Huerta dared to
raise his voice against the fashion and the learning,
which undervalued the primitive dramatic school of his
country. His poetical reputation, and some tragedies
which he wrote, made him a formidable antagonist of the Gallicists; and since that time, the turn of public opinion in Europe has been certainly rather against, than in favour of the poetical system which he attacked. It cannot be disguised, however, that Huerta, who avowed himself the advocate of the ancient Spanish poets, and who was one of the first of our national critics, appears as if, in spite of himself, the imitator of the French poets in his practice, and has even accommodated the Zaire of Voltaire to the Spanish theatre.

It is singular, that, as far back as during the reign of the mysteries and moralities, the French language should have to boast of more than one very good farce. The Avocat Patelin, which has really a humorous and well-conducted plot, is supposed by Fontenelle to be as old as the time of Louis XII. Another, entitled, "Les morts vivants," which has also a great deal of pleasantry, is as old as the 16th century. But the genuine French drama, after some regular, but feeble attempts at tragedy, by Jodelle, Mairet, Hardi, Rotrae, and a few others, can only be said to have commenced with Corneille. As a critique on this writer has been already given in our work, we shall content ourselves with referring to that article, and proceed to consider the character of their successors, Racine, Voltaire, and Crebillon, who have since carried the French tragic drama to all the perfection of which it appears to be susceptible, consistently with the narrow and limiting principles by which it is guided. Racine, without the pomp and ambitious conceptions of Corneille, is at the same time free from his turgidity. None of his plots have the bold and natural variety of action, which charms us in the drama of Shakespeare; but his art in arranging, opening, and thickening a plot, is that of a master. Such also is his skill in the management of his scenes, in adding to the embarrassment and increasing the interest of the piece; and his felicity in never leaving the stage empty, or occupied by characters brought on for the sole purpose of filling it. In his language, there is delicacy, purity, and harmony. A simplicity noble, but not ostentatious. A style at once judicious and beautiful, which, without appearing to feel the fetters of rhyme, expresses at once the fiercest declamatory passions, and the subtilities of moral reasoning. The perfection of his language is so great, that all his excellence is lost in representation. His pieces are highly finished, and exquisite pictures, which, to discover their full excellence, must be inspected at leisure, and with reflection. The shades of his bewitching poetry, according to the critics of his own country, (who, in point of style at least, are best entitled to judge of him,) are so delicate, that it is difficult to find actors capable of conceiving and expressing them. The strongest things that can be said to the detriment of Racine's merit, seem to apply rather to the cast of his national drama, and to the language in which he wrote, than to his own genius. The language in which he wrote is unfit for blank verse, and, by the bondage of rhyme, must of necessity give a narrowed and straitened expression to the utterance of passion. The severe dogmas of esthetic grammar chained him to the unities, as far as it was possible to observe them. It may be fairly said, that, without altering the genius of the French stage, if not of their language, it is impossible to reach a finer or more affecting and natural tone of poetry, than that which breathes throughout his Phedra and Berenice.

Drama.

Racine.

History of the French drama.

Cornelie.

Voltaire.

Racine.

Crebillon.

graces are like those of a cultivated landscape; while those of Shakespeare are like the views of a vast wilderness, interspersing horrors with exuberance of sweets. His own countrymen have objected monotony of character and sentiment to Racine; but this charge, at least in comparison with Corneille, appears to be frivolous. It is really Corneille who may be accused of too much uniformity. In Corneille's pieces, the names alone are varied. The characters and passions are the same. The sentiments are alike in all. Haughtiness, pretended Roman magnanimity, sometimes swelled to a gigantic size, are constantly the prevailing features; and desire of revenge frequently too atrocious for nature. Of six or seven pieces of Corneille which are in representation, this unnatural spirit of revenge is the ground-work of four; the Cid, Cinna, Rodogune, and the death of Pompey. Chimene, Corcelia, and Emilia, all demand the punishment of a father or a husband; and the abominable Cleopatra, in Rodogune, enumerates revenge, among her pretences for the horrors which she mediates. Racine would have probably diversified his theatre much more, had he not renounced the exercise of his genius when it had attained its full vigour. Britannicus, Iphigenia, Bajazet, Phaedra, Athalie, have no common similitude to each other. He has delineated but few passions, because he wrote but few pieces. His disgust at the criticisms of a finical age, co-operating with some superstitious scruples about the moral effects of the stage, unhappily consigned him to inactivity.

Voltaire aspired to an original manner in his native drama, by giving a greater variety and multiplicity of portraits to it, than are found in either Corneille or Racine. Far inferior to Racine in beauty of expression and style, and without those touches of sentiment and tenderness, which win the heart in that author, he has introduced a greater variety of human manners and situations on the stage, than any of his native predecessors. In A†ira, the customs of America are opposed to those of Europe. In the Orphan of China, the virtues of a civilized people are contrasted with the violence of barbarians. In Tancred, there is a display of the pomp and circumstance of chivalry. The intrigues and crimes of courts are unveiled in Semiramis.—He adds to this merit, that of a highly philanthropic and philosophical strain of sentiment. In Voltaire's theatre, there are no gratuitous horrors—no straining at the sublime by detestable accumulations of enormity. In this respect, both Voltaire and Racine stand respectively in comparison with Corneille, and with Crebillon, who, appearing as a competitor with Voltaire, was for a time upheld in the opinion of a giddy public, by some horrible tragedies, now justly fallen into oblivion. The secret of tragedy, Crebillon seems to have believed to consist in inventing monsters of villany. In his A†re et Thyeste, he superadds to the guilt which the Greek fable ascribes to the sons of Tantalus, contrives a plot of a double paricide, and concludes the piece, by making a villain declare that he now enjoys the fruit of all his crimes. The French tragic drama is professedly founded on the principles of the ancient Greek tragedy.

Without detaining the reader with any dissertation on the topic subject of the unities; without staying to inquire how far the French critics have over-rated their importance, it may be generally conceded to the French, that the structure of their plays preserves a compactness and symmetry superior to that of any other stage, and more entitled in that respect to the appellation of clas-

* The horrid piece of Oedipus cannot be fairly pleaded against Voltaire in this respect, as it was written so early in his dramatic career...
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Drama.

But classical simplicity reaches no farther in their national drama, than to the mere arrangement of scenes. Their language, their characters, their manners, (we may, without partiality, except some exquisite touches of nature in Racine,) have an exceedingly forced and artificial air. Their eloquence is rhetorical and declamatory. Their passions evaporate in description; and the limitation of poetic language to a certain range of expressions, out of which the sustained style cannot wander, gives a monotony still further increased by the incessant clank of its rhyme. We cannot, however, but repeat, with deference to the name of Racine, that, under all the disadvantages with which he laboured, love speaks in his pages with a sweetness and grace that is always enchanting.

It would be injustice to the genius of France to leave unnoticed the pre-eminence of her comic muse. Three nations of modern Europe may dispute the palm of comedy,—Spain for comedies of intrigue, France and England for those of character. Frequently, perhaps generally, all French and English comedies have a full mixture both of intrigue and portraiture of character; but in that of Spain, the former evidently prevails, whereas, when we come to ask in what consists the exquisite proof of Shakespeare's or Molière's comic powers, we should say, that it is not in contriving a plot, but in displaying the picture of a Falstaff or of a Tartuffe.

The love of comparison may induce us to ask, whether our great compatriot Shakespeare, or the Frenchman, has best succeeded in the portraiture of comic character? This question we presume to suggest, not to solve. The question may be suggested, for it is not a comparison of the portraiture of national manners, but of human nature taken at large. This merit belongs in common both to Shakespeare and Molière. Falstaff is a man comprising the whole world of wit, humour, and laughable vice within himself. The Tartuffe and Avare of Molière, are respectively the consummate portraiture of knavery and avarice, in their most amusing shapes. It is perhaps comparing excellence of different kinds, rather than of different degrees. But the latter, viz. Molière's picture of character, is analogous to what painters would call the hard style; and if humour be the test of comedy, we might with some hesitation pronounce Falstaff to be the more exquisitely comic. The characters of Molière, however, have the undoubted superior merit of being more defined, and less ambiguous than that of Shakespeare's. An essay of no small ingenuity has been written, to prove that Falstaff is really not intended by Shakespeare to be held up as a coward; and it is impossible to read that essay without entertaining some doubts upon the subject. But no stretch of human ingenuity could make us sceptical, for a moment, as to the intention of Molière, with respect to his strong comic characters; and, indeed, when we reflect upon the strength of Molière's drawing, we may well pardon the hardness of his likenesses. The vices of Falstaff, on the other hand, are like his fat form, sleek and undetermined. Molière's villains show, as it were, the skeleton and anatomy of comic nature. One material difference between the two authors is, that Shake-}

* As a general position, the superiority of plays of character over those of plot or intrigue may be asserted; at the same time, exquisite invention of intrigue is a gift of genius which should not be underrated; and though we hesitate not to consider the Spanish drama as deficient in character-painting, yet Calderón, the Shakespeare of Spain, gives such a spirituality to his plot, and makes the incidents which excite a breathless expectation, and a gay convulsion of the curiosity in their transition, so much connection with the character of the personages, that we sometimes may fairly admire him as a painter of character, through the medium of incidents. An exquisite instance of Calderon's comic powers, is his El Secreto a Voz, the best comedy of intrigue that ever the world witnessed—a comedy of intrigue, however, in which there is much mixture of character.
kind of drama may be obtained. The subject of Every Man is the summoning of man out of the world by Death, and its moral, that nothing will then avail him but a well-spent life, and the comforts of religion. This subject and moral are opened in a monologue spoken by the messenger, (for that was the name generally given by our ancestors to the prologue on their rude stage.) Then God is represented, who, after some general complaints on the degeneracy of mankind, calls for Death, and orders him to bring before his tribunal Every Man, for so is called the personage who represents the human race. Every Man appears, and receives the summons with all the marks of confusion and terror. When Death is withdrawn, Every Man applies for relief in this distress to Fellowship, Kindred, Goods, or Riches, but they successively renounce and forsake him. In this disconsolate state, he betakes himself to Good-Dedes, who, after upbraiding him with his long neglect of her, introduces him to her sister Knowledge, and she leads him to the holy man Confession, who appoints him penance. This he inflicts upon himself upon the stage, and then withdraws to receive the sacraments of the priest. On his return he begins to wax faint; and after Strength, Beauty, Discretion, and Five Wits, have taken their leave of him, gradually expires on the stage; Good-Dedes still accompanying him to the last. Then an angel descends to sing his requiem, and the Epilogue is spoken by a person called Doctour, who recapitulates the whole, and delivers the moral. From this analysis it may be observed, that Every Man is a grave solemn piece, not without some rude attempts to excite terror and pity, and therefore may not improperly be referred to the class of tragedy. It is remarkable, that in this old simple drama, the fable is conducted upon the strictest model of the Greek tragedy. The action is simply one; the time of action is that of the performance; the scene is never changed, nor the stage ever empty. Every Man, the hero of the piece, after his first appearance, never withdraws, except when he goes out to receive the sacraments, which could not be well exhibited in public; and during his absence, Knowledge descents on the excellence and power of the priesthood, somewhat after the manner of the Greek chorus. And, indeed, except in the circumstance of Every Man's expiring on the stage, the Samson Agonistes of Milton is hardly formed on a severer plan. The other play is entitled Hick Scornor, and bears no distant resemblance to comedy; its chief aim seems to be to exhibit characters and manners, its plot being much less regular than the foregoing. The Prologue is spoken by Pity, represented under the character of an aged pilgrim; he is joined by Contemplation and Perseverance, two holy men, who, after lamenting the degeneracy of the age, declare their resolution of stemming the torrent. Pity is then left upon the stage, and presently found by Freewill, representing a lewd debauchee, who, with his disolute companion Imaginacio, relate their manner of life, and not without humour, describe the stews and other places of base resort; they are presently joined by Hick Scornor, who is drawn as a libertine returned from travel, and agreeably to his name, scoffs at religion. These three are described as extremely vicious; who glory in every act of wickedness. At length two of them quarrel, and Pity endeavours to part the fray; on this, they fall upon him, put him in the stocks, and there leave him. Pity, thus imprisoned, descents in a kind of lyric man-

D R A M A.

Drama of England.

Account of the old drama of Every Man.

Drama in the reign of Henry VIII.

In the time of Henry VIII. one or two dramatic pieces had been published under the classical names of tragedies and comedies. Bale applied the name of tragedy to his God's Promise, in 1538; and, in 1540, John Falsgrave republished a Latin comedy, called Acolastus, with an English version; but these appear not to have been intended for popular use: it was not till the religious ferment had subsided, that the public had leisure to attend to dramatic poetry. In the reign of Queen Elizabeth, tragedies and comedies began to appear in form; and could the poets have persevered, the first models were good. Garboine, a regular tragedy, was acted in 1561; and Gascogne, in 1566, exhibited Jocasta, a translation from Euripides, as also the Supposes, a regular comedy, from Ariosto, near thirty years before any of Shakespeare's were printed. The people, however, retained a relish for their old mysteries and moralities, and the popular dramatic pocts seem to have made them their models. From the graver sort of moralities, our tragedy appears to have derived its origin, as our comedy evidently took its rise from the lighter interludes of that kind. As most of these pieces contain an absurd mixture of religion and buffoonery, Bishop Warburton has derived from thence our 'unnatural tragi-comedies.' Indefensible, however, as tragi-comedies are, upon the cultivated and genuine principles of art, they may be barbarous, but are not so well entitled to the epithet of unnatural; and it seems unnecessary to trace back the origin of tragi-comedy to any circumstance, except the primitive rudeness of human taste, to which, at a certain era in all countries, the mixture of the ludicrous and the serious seems to be perfectly congenial.

After tragedy and comedy had got possession of our stage, the moralities still kept their ground. One of them, entitled The New Custom, was printed so late as 1572. At length they assumed the name of masques, and, with some classical improvements, became, in the following reigns, the favourite entertainments of the court. The old mysteries, (says Dr Percy,) which ceased to be acted after the Reformation, appear to have given birth to a third species of stage exhibition, which, though now confounded with tragedy and comedy, were, by our first dramatic writer, considered as quite distinct from them both. These were historical plays, or histories; a species of dramatic writing which resembled the old mysteries, in representing a series of historical events, simply in the order of time in which they happened, without any regard to

* These are frequently exhibited as five distinct personages on the Spanish stage, but our moralist has represented them by one character.
the great unities. These pieces seem to differ from tragedies, just as much as historical poems do from epic, as the Pharsalia does from the Iliad. The popularity and dramatic cast of the series of poems called The Mirror of Magistrates, Dr Percy conceives to have contributed to make dramatic poetry have this historical form. It has been justly remarked by Watson, that the early practice of performing plays in schools and universities, greatly contributed to the improvement of our drama. While the people were amused with Skelton’s Trial of Simony, Bale’s God’s Promises, and Christ’s Descent into Hell, the scholars of the times were composing and acting plays on historical subjects, and in imitation of Plautus and Terence. Hence, ideas of legitimate fable must have been imperceptibly derived to the popular and vernacular drama. In confirmation of this, Mr Malone observes, that the principal dramatic writers, before Shakespeare appeared, were scholars: Greene, Lodge, Peele, Marlowe, Nash, Lily, and Kyd, had all a regular university education. From whatever cause it may have arisen, the dramatic poetry, about this period, certainly assumed a better, though still an exceptionable form. The example which had been furnished by Sackville was quickly followed, and a great number of tragedies and historical plays were produced between the years 1570 and 1590; some of which are still extant, though by far the greater part is lost. At length, about the year 1591, the great luminary of the dramatic world blazed out, who singly besotted a richer theatre to his country, by his own writings, than the three successive luminaries of the Greek drama gave to Greece in the course of an age. The dramatic glory of England was divided, in point of time, between the latter years of Queen Elizabeth’s reign, and the prior of King James’s reign. It was supported (as it will be hardly necessary to remark) by Shakespeare; but one or two of the minor dramatists of the same age, in particular scenes and passages, and even in some particular traits of dramatic merit, were worthy of being his contemporaries. Among these, we may reckon Massinger, who approached to Shakespeare in dignity; Beaumont and Fletcher, who rivalled him in drawing female characters; and Jonson, proverbially celebrated for the depth of his learning, and the efforts of his learned labour. Until the suppression of the stage by the revolutionary Puritans, the drama continued to be cultivated as the most popular species of poetry; and the works of Ford, Marston, Brome, Shirley, Chapman, and Decker, though no piece of entire and first rate excellence can be ascribed to any of these names, nevertheless exhibit passages of powerful eloquence, and of deep though irregular sensibility. The bounds to which this article has been unintentionally extended, will not admit of individually detailing the characters of those writers; but we cannot omit remarking the style of Chapman, though his general dramatic character is not great, as giving a fair idea of that full and heightened style, which he occasionally possesses in a very fascinating degree. In didactic and descriptive passages, he seems the nearest of our old writers to the manner of Shakespeare. The following lines, we hope, will justify the opinion.

Opinion, the scale of good or bad;—in the tragedy of Byron’s Conspiracy:

There is no truth of any good
To be discern’d on earth; and by conversion,

Nought therefore simply bad; but, as the stuff
Prepared for ass’s pictures, is no picture
’Twill not be found, and must be left with the beams
Of his imaginative fancy through it.
In forming ancient kings and conquerors
As he conceives they look’d and were attir’d,
Though they were nothing so: so all things here
Have all their price set down from men’s conceits;
Which make all terms and actions good or bad,
Which are but plaint and well-coloured threads
Put into flegned images of truth.”

Contempt expressed against the absurdity of astrological calculations:

1. I am a nobler substance than the stars;
And shall the baser order rule the better?
Or are they better, since they are the bigger?
I have a will and faculties of choice,
To do, or not to do, and reason why
I do, or not do this: the stars have none.
They know not why they shine more than this taper,
Or how they work, nor what. I’ll change my course,
I’ll piece-meal pull the frame of all my thoughts;
And what are all your capital then,
Your planets all being underneath the earth
At my nativity? what can they do,
Malignant in aspects in bloody houses?"

Henry the Fourth of France blessing the young Dauphin.—from Byron’s tragedy:

"My royal blessing, and the King of Heaven
Make thee an aged and a happy king.
Help, nurse, to put my sword into this hand;
Hold, boy, by this, and with it may thy arm
Cut from thy tree of rule all trait’rous branches
That strive to shadow and eclipse thy glories:
Have thy old father’s anger for thy guide;
Redoubled be his spirit in thy breast,
Who, when this state ran like a turbulent sea
In civil hate, and bloody enmity,
Their wrath and envies, like so many winds,
Seized and burst; and, like the halcyon’s birth,
Be thine to bring a calm upon the shore,
In which the eyes of war may ever sleep."

His soliloquy, delivering the death of a traitor:

"O thou that governs the keen swords of kings,
Direct my arm in this important stroke,
Or hold it, being advanced—the weight of blood,
Ev’n in the basest subject, doth exact
Deep consultation in the highest king:
For in one subject, Double unjust affrights,
Passions and pains, though he be near so poor,
Ask more remorse than the voluptuous spleens
Of all kings in the world deserve respect.
He should be born grey head’d that will bear
The weight of empire. Judgment of the life,
Free state, and regulation of a man,
If it be just and worthy, dwelleth so dark,
That it denies access to sun and moon.
The soul’s eye, sharpened with that sacred light,
Of which the sun himself is but a beam,
Must only give that judgment.”

The reign of Charles is distinguished in his dramatic annals by the name of Otway, who, in the pathos of Otho’s tragedy, is incomparably the master genius of the English stage. No writer has touched the string of domestic distress with so much force and feeling. His language has at once the graces of fancy and the tone of nature. His affecting situations, like those of Esquivali, are drawn from the deepest resources of tragic art; and his fables (excepting those scenes of buffoon-
D R A

DRAPESTES, a genus of plants of the class Tetranteria, and order Monogynia. See Botany, p. 132.

DRAWEAK, a custom-house word, denoting the amount of duty repaid, or, in other words, drawn back, on the exportation of particular articles of merchandise. Drawbacks proceed on the principle, that it is politic to avoid burdening our exports with any extra charges, whatever we may do in regard to home consumption. The writers on commerce generally consider them along with bounty; but while the policy of the former is commonly very questionable, there can be no doubt of the expediency of the latter. To allow a drawback, is, in fact, nothing more than to leave the article as we found it; but bounties operate to give a forced direction to the employment of capital. In many articles, our duties of custom or excise are so heavy, as to make the amount of drawback considerable, and to render the grant of it a matter to be accompanied with great precautions. The exporting merchant must make oath of the former payment of the duties in question; and, in the event of fraud, both forfeiture of the goods, and a penalty in addition, are incurred. Fraud, in the case of drawbacks, is apprehended less from misrepresentation at the customhouse, than from attempts to reland clandestinely, for the purpose of sale at home, the very goods, for the exportation of which the drawback had been obtained. The law accordingly enacts the forfeiture of all vessels, carriages, or appurtenances used in the relanding, along with the forfeiture of twice the drawback, by the party concerned in this iniquitous transaction. (x)

D R A W I N G.

D R A W I N G, or Design, is that part of the art of painting which relates to the terminations, contours, boundaries, of objects in whole, and in their parts. In sculpture it extends no further than to the geometrical arrangement of those terminations, according to their real figure and proportion; but in painting there is superadded to this, the consideration of the perspective appearance of this proportionate arrangement of figure, as viewed from one point. This is called drawing, by way of excellence, to distinguish it from all mere geometrical regular delineations, and is undoubtedly the highest and most comprehensive mechanical excellence of the art.

As all the considerations of sculpture are therefore necessarily included in drawing, and make but a part of it, those principles in which the chief excellence of drawing consists, must be considered as equally applicable to sculpture, as far as it goes. The designer must be conversant with those laws of gravity by which alone all bodies are sustained in action or in motion, by the necessary regulation of an equilibrium in their parts. He must likewise dispose and arrange, in true perspective, all his objects in their proper situations, and relative magnitudes, distinguishing the several qualities of surface, whether of trees, of rocks, of buildings, or of draperies, according to the economy and character of the parts peculiar to each. As the human figure combines a greater variety of important considerations than that of any other subject whatever, all the great designers have devoted themselves to the study of it with such peculiar predilection, that the terms correct drawing, a skilful draftsman, and the like, almost exclusively refer to the skilful delineation of the human body. All the different styles of design may be classed under the three following heads:

1. The indiscriminate representation of ordinary and familiar objects, with all the imperfections and peculiarities of the individual model. This is the vulgar idea of the imitation of nature, and in it nothing is required as far as relates to style and character, but skill and accuracy of the eye and hand. This was the department of art which the Dutch school adopted.

2. The selection of nature, or the representation of Select an objects selected from the mass, with some particular view or design.

3. The grand style, (Beau Ideal, Gran' gusto,) which Grand style is the selection and judicious combination of different
The ideal style comprehends propriety of attitude, elegance of contour, choice of expression, play of drapery, in short, every thing that can elevate individual nature, to the most sublime conceptions of the imagination. "It is not easy," says Reynolds, "to define in what this great style consists, nor to describe by words the proper means of acquiring it. But though there neither are nor can be any precise rules for its exercise or acquisition, yet we may truly say, that it will always be obtained in proportion to our attention in observing the works of nature, to our skill in selecting, and our care in digesting, methodising, and comparing our observations. The power of discovering what is deformed in nature, or, in other words, what is particular or uncommon, can be acquired only by experience, and the whole beauty and grandeur of the art consists in trying to get over all singular forms, local customs, peculiarities, and details of every kind.

"All the objects which are exhibited to our view by nature, upon close inspection, will be found to have their blemishes and defects: but it is not every eye that perceives these blemishes; it must be an eye long used to the contemplation and comparison of these forms, and which, by a long habit of observing what any set of objects of the same kind have in common, has acquired the power of discerning what each wants in particular. This long laborious comparison should be the first study of the painter who aims at the highest style. By this means he acquires a just idea of beautiful forms; he corrects nature by herself, her imperfect state by her more perfect, his eye being enabled to distinguish the accidental deficiencies, excrescences, and deformities of things from their general figure; he makes out an abstract idea of their forms more perfect than any one original; and what may seem a paradox, he learns to design naturally, by drawing his figures unlike to any one object. This idea of the perfect state of nature, which the artist calls ideal beauty, is the great leading principle on which works of genius are conducted."

Beauty or perfection then, is that form of bodies arising from a complete harmony in all their parts, corresponding with the generic qualities of their several species, of whatever kind, sex, or age.

Pure simple beauty, or perfection, being equally adapted to all the several animal destinations proper to its species, is equally removed from the several classes of character which so evidently define and manifest their peculiar powers. Mere beauty of form, though always pleasing, (we speak here more particularly of that of the human body,) is incapable of exciting great interest, till it be combined with the expressions of sentiment and mind; then it becomes interesting and fascinating, and particularly when it is in action, and accompanied by the graces, its natural attendants, which, without altering any of its constituent parts, make the soul and sensations of the heart visible in the external figure, and which, still more in the female, by their affecting sensibilities, and happy transitions, produce on the whole, an air and aspect the most amiable, tender, and enchanting. But although the graceful is so eminently distinguishable, and carries with it such peculiar power in female action, yet it is by no means to be understood as confined merely to female action; for as grace is produced from the union and entire conformity between the tender sentiments of the heart, and the corresponding mild and easy actions of the body, every action or movement of a perfect and beautiful body of either sex, may, even of almost any species where this union is visible, must be graceful. Hence arise that grace, elegance, and dignity of attitude and gesture which we so much admire in the Greek statues; not that these qualities consist in any particular lines of beauty, or depend on the impressions which any specific forms make on the organs of sight, but on the contrary they arise wholly from mental sympathies and associations; and therefore the forms which appear graceful, elegant or dignified in a man, are totally different from those which appear so in a lion, a horse, or a dog, though all of these frequently display grace and elegance of form and motion in a high and eminent degree. There are certain postures into which the body naturally throws itself, and certain gestures which it naturally displays, when under the influence of particular passions and dispositions of mind, so that from our own internal feelings and sentiments, we learn to associate the ideas and notions of certain tempers and characters of mind with those of corresponding attitudes and modes of carriage of the body, as we do more immediately and unconsciously from the features of the face. Upon this principle, dignity of attitude is that disposition of the limbs and person, which, from habitual observation, we have learned to consider as expressive of a dignified and elevated mind, while grace and elegance of form are those dispositions and combinations of motion or attitude, which, upon the same principle, seem to express refinement of intellect, polish of manners, and pleasantness of temper; for though we apply the words grace and elegance to inanimate objects, it is always by metaphor and analogy, as we speak of lightness and heaviness of form, although we know that gravitation has no connection with form, but depends entirely on substance.

In the fine age of the arts in Greece, civilization had just arrived at that state in which the manners of men are polished, but natural, and consequently their attitudes and gestures expressive and emphatical, without being coarse or violent; all the more noble and amiable sentiments of the mind were indicated by the correspondent expressions of the countenance and body; their modes of dress, too, having been adapted to display to advantage the natural motions and gestures of the body, and not to constrain, disguise, and conceal them, like those of modern Europe, the artists had continually before their eyes every possible variety of models. In the pagan festivals, too, where men of high rank and liberal education entered into contests of personal strength and agility, they had opportunities of seeing muscular effort and exertion in every mode and degree. By studying these models, and not by resorting to any abstract rules, or predeterminate lines of beauty or grace, the ancient artists seem to have produced those great masterpieces of art; for, as to particular lines, there are none that may not be graceful, elegant or beautiful, in proper circumstances and situations, and none that are not the reverse, when improperly employed. Accordingly the design of the ancients is distinguished by an union in the proportions, a simplicity of contour, an excellence of character, and a gracefulness of action. If we observe the attitudes and movements of the Greek statues, we cannot fail to mark that careless decency, and unaffected grace, which ever attend the motions and gestures of men unconscious of observation. The ancients could not but derive peculiar advantage from the observation of those living models of elegant and unconstrained nature, which were perpetually before their
eyes. Hence that singular simplicity which characterises their works; for though at times, as in the Venus de Medici, and the daughters of Niobe, they rise to an assumed gracefulness, yet this is confined to so simple a contour, it is so little above the measure of ordinary action, that it appears less the effect of study, than the natural result of a superior character, or an habitual politeness.

We have selected the following statues as specimens of ancient art; each possessing a distinct and well-defined character, in form, proportion, and expression, and may be considered as the head and representative of the class to which it belongs.

Of all the remains of ancient art, there is none that can be compared to the fragment of the Hercules, commonly called the Torso of the Belvedere. In point of sublimity and grandeur of stile, it is unique; it is the most complete system, or combination of parts, that can possibly be conceived, for the idea of corporeal force, which it was intended to convey; the character of all the parts most perfectly corresponds with each other, and with the general idea of the whole. The length and taper form of the thighs are well calculated to obtain the victory in the foot race, which Hercules won at Olympia; but their agility appears more the effect of force than of lightness, and they are in perfect union with the loins, abdomen, chest, and back, which exhibit a power that might well crush Antens. Compared with this, the Hercules Farnese, though possessing much beauty, is heavy and inert. In order to give a more decided character of strength, as is thought by some, the artist has borrowed from the bull the thick- ness of his neck, and the hair of his forehead. The practice of the ancients in giving a character of divinity to their gods and deified heroes, was to suppress the veins and sinews, as is observed in the Torso, Apollo, and others. In the Torso, he is represented as purified from the grosser parts of human nature, and arrived at the felicity of the immortals. The Farnese Hercules is still in the middle of his labours, and man is impressed on the whole figure.

Of all the productions of art, which have escaped the ravages of time, next to the Torso, the Apollo Belvedere is by far the most sublime: his stature is above that of man, and his whole attitude breathes majesty. Here is nothing mortal, nothing that seems subject to the wants of humanity. His body is not heated by veins, nor agitated by nerves, and a celestial spirit is spread over the whole figure. He has overtaken Python, and in his rapid course, has just transfixed him with his mortal weapon.

In the group of the Laocoon, the great aim of the artist has been to impress on the mind of the spectator, those emotions of terror and pity, which arise from that climax of distress, exhibited in the unavailing efforts of an agonised father and his children; the children calling on the father for assistance, and he upon heaven, which has abandoned him to his fate. The forms of the children are full of grace and beauty, and the noble, vigorous, athletic figure of the father, is admirably calculated to exhibit those convulsive writhings which agitate every member. Besides the variety arising from the different ages and characters of the figures, their actions are so diversified, that, in every point of view of this admirable group, the eye is presented with a combination of circumstances and aspects, so beautifully varied from each other, that it is difficult to say which is most to be admired—vital energy, direct, and uniform address of the subject, or the graceful and skilfully variegated manner in which it is communicated.

The Venus de Medici is remarkable for the beautiful expression of her countenance, the elegance and grace of her attitude, and the sweetness and delicacy of her form. This figure has always been considered the model of female perfection, and is a fit representative of the queen of beauty.

The Antinous of the Belvedere, as it is commonly called, has a just claim to be ranked among the finest remains of ancient art; but more for the beauty of the parts, than the perfection of the whole. The lower parts of the body, the legs and feet, are much inferior, both in form and execution, to the rest of the figure; the head is, without controversy, the most beautiful of that class of character now extant. The face of the Apollo Belvedere indicates stateliness and majesty; but that of the Antinous presents the graces of youthful beauty, accompanied with native innocence, without the indication of any passion capable of disturbing the harmony of parts, and the repose of mind, impressed on every feature; his eyes, arch’d with a gentle inflexion, speak a language full of innocence; his cheeks form a fine combination with his elevated and rounded chin, and complete the graceful contour of this noble youth. His chest is powerfully elevated; his shoulders and sides are of a most finished beauty, but his legs are deficient in that fine form, which such a body requires, and his feet are of a coarse and ordinary execution.

The statue known under the name of the Gladiator Borghese, comes next to be considered: The Torso of the herculis, and the Belvedere Apollo, above described, offer the idea in its greatest perfection. The group of the Laocoon presents nature elevated and embellished by the ideal, and by expression; but the merits of this statue consist in the assemblage of the natural beauties of an adult man, without the addition of any thing from the imagination.

The preceding figures are like an epic poem, which, passing from the probable beyond the true, leads to the marvellous; whilst the Gladiator is like history, which candidly exposes the truth, but with the finest choice of thought and expression. The air of his head shews clearest that his form is taken from an individual model; his whole physiognomy presents the idea of perfect manhood, the structure of his members, the traces of a life constantly active, and a body hardened by fatigue.

The arts of design had long been cultivated in Greece, and by the time of Pericles they had arrived at the highest perfection. From that period to the time of Alexander the Great, history presents us with a long and brilliant list of men, whose works in art, as well as letters, have been the admiration of every succeeding age. During this period were produced almost all those stupendous works of ancient art, which have ever since been the standard of legitimate taste, and to which we are solely indebted for all that is great or excellent in modern art since its revival. This was the age of Phidias, Polycletes, Myron, Parrhasius, Zeuxis, and Apelles; and although a general purity of conception is observable in almost all the works of the ancients, even to the lowest class; yet it is to the productions of this time only that the term antique, as a model of perfection, can properly be applied.

Our limits do not permit us minutely to trace the various fluctuations of the arts of design, from this period to their total extinction during the middle ages;
we shall therefore confine ourselves to a very brief epitome of their history.

Under the successors of Alexander the Great, the arts maintained their respectability and consideration till the destruction of Corinth by Lucius Mummius, when the liberty of Greece was buried in its ruins, and all the finest monuments of art were carried to Rome to decorate its triumph. This example was followed by Metellus in Macedonia, after the defeat of Perseus; from this country he took an incredible number of statues, with which he embellished the capital, and the famous portico which bears his name; and Sylla, on the taking of Athens in the war of Mithridates, completed the destruction of Grecian art. The Torso of the Hercules seems to be one of the last masterpieces produced in Greece before the total extinction of its liberty; for after this country was reduced to the form of a Roman province, history makes no mention of any celebrated artist, until the time of the triumvirate at Rome. The bringing to Rome so many fine works of art, seems first to have given to the Romans a taste for the arts of design. These conquerors, when they had relaxed from their severity, began themselves to cultivate the Greek arts as well as letters. The Roman people, sensible of the beauty of the productions of Greece, took pleasure in contemplating them; and that before the art was at all practised at Rome; they even became the protectors of it in its own country, by having statues executed at Athens for their country houses. Before the dictatorship of Sylla, the arts, though esteemed, do not seem to have met with any distinguished success, as during the republic, the Romans affected a simplicity of manners, and the enjoyment of a frugal mediocrity; but as soon as the laws of civil equality began to be subverted by the preponderance of some rich and powerful citizens, who, by luxury and magnificence, endeavoured to awe the people, and to stifle the republican spirit, the taste for the arts began rapidly to increase. Sylla was the first of those who governed Rome as a despot. The destroyer of the arts in Greece, he became their protector in Rome and Italy; he surpassed all in the splendour and sumptuousness of his buildings; Clodius, Lucullus, Lepidus, Pompey, and others, adorned their palaces and gardens with statues; and Caesar, when he conquered the empire, besides erecting superb edifices in Italy, Gaul, Spain, and Greece, made magnificent collections of engraved stones, and of pictures of the ancient masters. Augustus decorated the public places, and even the streets, with statues of the gods, and placed in the portico of his forum those of the most illustrious Romans who had contributed to the glory of their country. The arts of design were now firmly established at Rome, which was filled with artists from Greece, as well as its own natives, who all aspired to honour and emulation under the auspicious influence of imperial patronage. This forms another brilliant epoch of the art. It was now arrived at its climax; but it seems to be the lot of art not to remain long stationary. The train of monsters who immediately succeeded Augustus, brought on a premature decay; and, notwithstanding the countenance and encouragement it received from the Vespasians, Nerius, Trajan, Adrian, and the Antonines, the decline was rapid and uninterrupted; and by the time of Charlemagne, it had sunk to the lowest state of barbarism and degradation, and so continued till the time of Cimabue. Although the renovation of the arts in Rome has generally been attributed to Cimabue, it is certain that they were cultivated for nearly two centuries before him, and, it is supposed, principally by Greeks. The Mosaic pictures at St. Mark's at Venice sufficiently show the low state of the art at this time, being without light and shadow, in miserable drawing and proportion, and the figures standing on the points of their toes. Cimabue began to find out the defects of this manner; and his disciple Giotto, improving on the discoveries of his master, by giving an air to his heads, attitude and motion to his figures, and even attempting the passions and affections of the soul, and more natural folds to his drapery, laid the foundation of that vast fabric of excellence, which, after the gradual improvement of two centuries, and the successive labours of Ghiberti, Brunelleschi, Masaccio, Andrea Mantegna, and their followers, was at last perfected by the genius of Leonardo da Vinci, Michael Angelo Buonarotti, and Raffaelle. Leonardo da Vinci, besides strength and manliness of design, gave all that subtle detail of the exactness of nature; and in the stronger expressions, he seems to have gone farther than any contemporary or succeeding artist, in marking the emotions of the soul in the actions and countenance; and his enthusiasm, though great, is always equalled by the coolness and solidity of his judgment. Although the researches of Leonardo da Vinci were extended to all the parts of painting, his sagacity was so effectual in each, that it may be truly said that the greater part of the excellencies of some of his most distinguished successors was owing, in a great measure, to the discoveries of this scientific and philosophical artist.

Michael Angelo, by the study of anatomy and the antique, had possessed himself of such powers in the naked, as had never been known before him: he formed his taste very much from the Torso, and other ideal statues of antiquity; yet, notwithstanding the vastness and sublimity of his conceptions, his noble enthusiasm, and the correctness and greatness of his style, his works are chargeable with a great want of variety of character, as that of the Torso is too prevalent in them all. His character, however, as a designer, has always been esteemed, as design itself was cultivated and understood; and if his reputation has diminished in latter times, it is because this part of the art has been less attended to, than those that are more showy and superficial. No man has delineated, with more skill, those actions that require spirit and energy; and none, since the revival of the art, has ever equaled him in elevation of sentiment, unity of idea, and consummate knowledge of the figure. See Buonarotti and Raffaelle.

Raffaelle's design was, in its beginning, like that of his master, Pietro Perugino, dry, but correct; he enlarged it much on seeing the drawings of Michael Angelo, though, in his smaller works, he never entirely got the better of that dryness of manner. Of too just an eye to give entirely into the excesses of his model, he struck out a middle style, which, however, was not so happily blended, nor so original, as to throw off the influence of the two extremes; hence, in the great, he is too apt to swell into the charged, in the delicate to drop into the little. His design is, notwithstanding, beautiful, though it never arrived at that perfection which we discover in the Greek statues. He is excellent in the characters of apostles, philosophers, and the like; but the figures of his women have none of that elegance which is seen in the Venus de Medici, or the daughters of Niobe; in these, his convex contours have a certain heaviness, which, when he seeks to avoid, he falls into a dryness still less agreeable. His great excellence in design is more a happy union of all its essential parts, than the energy of any one separately
considered. He possessed all those parts of the art in a high and respectable degree, particularly the expressive, which was his most characteristic and predominanting quality: he shews, in his works, a most beautiful and highly interesting chain of well reasoned and happily variegated incidents, a solid, manly judgment, a divine enthusiastic warmth, and an expressive energy, which have set him above all the moderns in this branch of the art.

Raffaello and Michael Angelo have thus carried the art farther than had ever been done before, and they have never been equalled since. If it be inquired, which of these two extraordinary men should hold the first rank, it will be answered, that if it is to be given to him who possessed the greater number of the higher excellencies of the art, it must be Raffaello. But if the sublime, which is the highest excellence that human compositions can attain to, compensate for the absence of every other beauty, and atone for all defects, then Michael Angelo demands the preference.

Titian's style of drawing is not remarkable for any excellency: he had but little selection, and was closely attached to whatever he saw that was not grossly faulty in the models he drew from; his forms, therefore, though well enough rendered, are generally imperfect; he was ideal and scientific in his colouring only.

On the contrary, Correggio, besides the charms of his chiar' oscuro, gave in his drawing more grace, delicacy, and sentiment, than any of his predecessors, though these beauties often degenerate in him to affectation and inaccuracy, particularly in his larger works. In his oil pictures, wherein he could revise and correct, his figures and expressions are better attended to; and the beauty, grace, and interesting sensibility of his female figures, strongly show how far Raffaello was short of him in this class of character. See Correggio.

The taste of design of Parmeggiano is often an improvement both on Michael Angelo and Correggio: he frequently possesses the spirit and intelligence of the one, with the grace, sentiment, and sweetness of the other. His figures have much spirit and energy of action; they are often singularly beautiful, and almost always graceful; the articulations of the joints show great agility and ease; they are of a fine length and beautiful form, and on the whole display great knowledge of the figure. These beauties are, however, often carried to excess, particularly in the extremities, in the movements and actions of his figures, which, though the seat of his greatest excellence, are frequently overpowered by too much spirit.

The Carracci formed a new style, by uniting all the parts of the art which had separately been cultivated by their predecessors, without giving particular attention to any one; and though they have not equalled the grandeur of Michael Angelo, or the expression of Raffaello, the grace and chiar' oscuro of Correggio, the strength and fine distribution of colour of Titian, their works in general combine more excellencies than had ever been brought together before. Agostino's style of design is better selected from nature, more large and noble, than that of Ludovico; and, from the great perfection he has displayed in many of his pictures, it must be regretted that he dedicated so much of his time to engraving.

The style of Annibal is like that of Ludovico, of a noble and enlarged character, and savours little of the poverty of defective individual nature: he improved greatly on his arrival at Rome, on seeing the great works of Michael Angelo and Raffaello, and above all of the antique, which opened to him new treasures of ideal beauty, of which before he had but a faint conception. The Farnese gallery clearly displays this advantageous change of style; and there is every reason to think, that his great talents, now transplanted to a more genial soil, would have appeared in still greater splendour, had not his career been terminated by a premature death. The vigour which Raffaello and Michael Angelo disseminated over the Roman school, (which was indeed very transitory), would have perished with their immediate disciples, had it not been for the Carracci and their followers, who for some time kept up the credit of sound design, against the meretricious practices of low imitation, and the trite, flimsy, and vague invention of the scholars of Carravaggio and D'Arpino.

The highest rank among the disciples of the Carracci must be given to Guido and Dominichino. The great aim of the former was sweetness, beauty, and divine grace in the airs of his heads, and the attitudes of his figures. He is ranked with the greatest artists of any age since the revival of the art. His style was peculiar to himself; the tender, the pathetic, the devout, in which he could display the sweetness and delicacy of his thoughts, were the subjects in which he excelled. In expressing the different parts of the body, he had a remarkable peculiarity of manner: he usually designed the eyes of his figures large, the nostrils somewhat close, the mouth small, the toes rather too closely joined, and without any great variety; the heads of his figures are accounted not inferior to Raffaello, either for correctness of design or engaging propriety of expression. His most distinguishing talent lies in that moving and persuasive beauty, which proceeds not so much from a regularity of feature, as from a lovely air he has of nothing, which he had the art to place in the eye; and in these qualities he has never been surpassed. Dominichino has been distinguished for fine character, strong and moving expression, sound drawing, and simplicity and variety in the airs of his heads. In these respects he is little inferior to Raffaello; his attitudes, however, are but moderate, his draperies are stiffly cast, and his pencil heavy. The design of Nicolo Poussin is simple, pure, and correct; he lived and conversed so long with the antique, that his works throw us back entirely to those times, and have more the appearance of ancient paintings than those of any of the moderns. His best works have a remarkable dryness of manner, which, though by no means to be recommended for imitation, seems perfectly to correspond with that ancient simplicity which characterises his style. With the severe and rigid manner of Poussin may be contrasted the florid and gay style of Rubens. Notwithstanding the amazing splendour of colouring, the magnificence of his composition, and the ease and dexterity of his execution; his drawing is coarse and vulgar, without dignity or character; and, in short, nothing can be farther removed from the true principles of legitimate art, and the purity and chasteness of the antique, than the general style of his design. His manner was followed by a numerous train of disciples, at the head of whom is Vandyke, who possessed all Rubens' excellence, with more grace and correctness.

The Dutch school has never directed its aim to any thing but imitation of individual nature; but, as far as that goes in the representation of drolls, conversations, landscapes, and sea pieces, and in seizing those transitory effects of light and sunshine, in beauty of colouring and chiar oscuro, and in the mechanical dexte-
rity of the pencil, the art has been carried to the highest point of perfection; and it is to be regretted that many of the painters of this school, in the humble sphere to which they limited themselves, have displayed talents which, if they received a proper bias, would have given them rank and eminence among those who have excelled in the higher departments of the art.

We have taken no notice of the French school; for although several artists of that nation, such as N. Poussin, Le Brun, Sebastian Bourdon, and Le Sueur, hold a high rank in the art; yet as the French taste has always been much more inclined to the frivolities and affectations of Watteau and others, than to the genuine principles of sound art, these must be considered rather as a colony of the Roman school.

Drapery. The judicious choice and disposition of the draperies, form another important subject for the artist's attention, whether considered as contributing to the expression of the character represented by the propriety of costume, or as affording additional assistance in giving grace to his figures; in uniting the parts of a group, or one group to another; or as forming a substratum on which he is to dispose the variety of colour and strength of chiar oscuro, so essential to the pleasing effect of his work. Its excellence consists in three things, viz. 1st, The disposition of the folds; 2d, The diversity of the stuffs; and, 3d, The harmony produced by the scientific arrangement of the colours.

The drapery, in its folds, should be so disposed, that the character of the form, and proportion of the figure, should appear, as far as probability will allow. It was usual for the great masters, first to draw their figures naked, and then to adapt their drapery to their position. Whatever be the motion of the figure, the folds of the drapery should always show distinctly the action and attitude of the figure, and the true position of the body. In the composition of many figures, attention must be paid in the folds to the variety produced by the qualities of thick or thin stuffs, as adapted to the characters of the several figures. In the representation of philosophers and prophets, in order to correspond with their dignity and gravity of deportment, the folds should be few and large. In men of elevated character, and matrons of a superior class, such as the Virgin Mary, and the disciples, the folds will not be so few nor heavy as in the former; and for nymphs or young females, the drapery will be light and thin, and the folds small and numerous. Regard also must be paid to the rank and condition of the several characters, in the introduction of suitable ornaments, such as jewels, embroidery, rich robes for queens, princes, &c. The introduction of diversity of stuffs, does not seem consistent with the dignity of historical composition, which is always degraded by individual representation. On this principle, the Roman, Florentine, and Bolognese schools, have never given greater variety to their stuffs than what was necessary for the difference of size in the folds. The Venetian school, on the contrary, which sacrificed every thing to the richness and splendour of effect, have taken the most unbounded license, even in those subjects where the most rigid severity of style would have been most appropriate, in the profuse introduction of silks, satins, brocade, and embroidery, which are only to be admitted in those conversations, and other subjects of individual life, in which the Flemish and Dutch schools have so pre-eminently excelled.

Drapery is also of essential service to the painter in the harmonious distribution of colour and chiar oscuro, and in stamping the character of solemnity or gaiety suitable to the subject; but we shall not enter on the further discussion of this subject, as it belongs to the two great parts of the art—colouring and chiar oscuro.

See Painting.

Raffaello, in his first works, imitated his master Pietro Perugino, in his drapery, as well as in every thing else. He somewhat improved his style from the works of Massaccio and Fra Bartolomeo di S. Marco. On seeing the works of the ancients, he abandoned altogether the schools of those masters, and adopting such rules as he formed from the study of the antique, for the natural folds of his drapery, he acquired that admirable taste by which his folds are distinguished, and in which he has never been equalled.

Correggio, in his drapery, kept always in view what was agreeable or pleasing. He very early quitted the manner of his predecessors in art; he, in general, painted his figures from small models, which he clothed with pieces of cloth or paper. He sought every where for masses, and in those masses for what was pleasing, in preference to the truth of individual folds.

Titian painted his draperies, as he did most other things, merely from imitation. He made them very beautiful, and strongly resembling nature, but exactly as he found them in the object before him, without choice in the folds.

The critical knowledge and just theory of the art, which are to be matured by the study of the antique and the works of the great masters of the Italian schools, must be founded on an intimate knowledge of the human figure, in its various states of action and repose, of the effect of the passions on the face and body, and its symmetry or proportions in its adaptations to the various characters of youth, manhood, or age; strength, agility, or delicacy, of plumpness or leanness; for the several degrees of which, in every possible combination, have each of them a conformity of parts, and a proportionate arrangement of relative magnitudes peculiar to itself; and this knowledge of proportion is only to be acquired by the accurate investigation of general nature in its approaches to the abstract of each character; and the more we are practised in this study, the better will we be enabled to appropriate to each character the peculiar proportions which constitute it. The antique statues are excellent examples of the mode of study to be pursued in adapting proportion to character, by a happy conformity of each to the other; and though they apply but to few characters, as but few remain entire, yet enough is left to point out the way; for the greatest absurdities must follow, when the proportions and form of the muscles are not adapted to the character of the figure; and the degree of muscular exertion to the occasion of calling it forth, as is the case with the works of Lanfranco, Pietro da Cortona, Carlo Cignani, Le Moine, and others, who have indulged so far in this fondness for some particular proportions, that their figures are all of the same family and character, with no difference but what arises from action, position, or age; and this can only be acquired by the study of anatomy, which is the grammar of painting. Without anatomy, the most careful examination of the figure will be of no avail. As the display of muscular action is but necessary to be fixed or retained, the effect produced upon the external surface of the body and limbs by the action of the muscles, the swelling and retiring of the fleshy parts, and the appearances of the sinews or tendons, which accompany all the varieties of exertion or change...
of posture, cannot be perceived with sufficient accuracy, without the knowledge necessary to classify the muscles engaged in the operation, and account for the changes of form superinduced on the surface by the various motions of the bones, particularly at the articulation of the joints in the different actions of flexion and extension; and it is only by a minute comparison of their forms and situations, as they appear on dissection, with the living subject put in every variety of action, that this knowledge can be attained. It was by this practice that the great masters, particularly Leonardo da Vinci, and Michael Angelo, acquired such profound knowledge, and such exquisite correctness of design; and there are still extant many highly finished drawings by them in this way, which abundantly prove with what indefatigable industry and minuteness of investigation they applied to this study.

The human figure, in various stages of existence, from infancy to maturity and old age, undergoes many changes, which, without invading the province of anatomy, we may briefly notice. Infants of both sexes bear a strong resemblance to each other, in form, delicacy of organization, plumpness and gait, and the size of the muscles. But after a few years, when the organs are more fully developed, the muscles of the male lose their original softness and rotundity; become firmer, larger, and of a more determinate figure, till at last the original rotundity entirely disappears; the muscles, particularly in action, are seen distinctly through the skin, and strongly indicate superior strength and activity. The delicate organs of the female never acquire the same bulk, strength, or rigidity, as those of the male: on the contrary, they retain their original softness and delicacy of texture; no rising muscle projects, to break the gentle undulations of the form. The form of the child's head is powerfully distinguished from that of the adult, by certain striking peculiarities; as nature, for wise purposes, brings the brain sooner to perfection than any other organ, its size, and that of its case the skull-cap, (or cranium), is larger in proportion than that of the body, and the face is remarkably small for want of the teeth and gums; but in its progress from infancy to youth, the growth of the teeth deepens both the upper and lower jaws, and to give room for the full set, the jaws are elongated: the bones of the nose are raised, the nose is lengthened, and the cheek bone is made to project, and the frontal sinews are formed, which complete the character of the adult. When the teeth fall out in old age, the alveolar processes which grew up with them, and supported them, are removed by absorption; and there remains nothing but the narrow base of the jaw, while the length of bone from the hinge of the jaw to the angle is undiminished. The jaws, then, are allowed to approach nearer each other at the face part, the angle of the jaw comes more forward, resembling that of the child, and the chin projects also. The teeth and adventitious parts of the jaws being gone, the chin and nose approach, the mouth is too small for the tongue, and the lips fall in. In their ideal figures, the ancients did not confine themselves strictly to the natural form of the head; their practice, by filling up the cavity between the forehead and nose, and thereby uniting them, and also by giving a greater projection to them than is ever to be found in nature, was to include both within one straight line. This deviation from the universal practice of nature, seems to have arisen in a desire to give a more exalted and divine character to their gods, heroes, and the like, by magnifying those proportions which constitute the distinguis

guishing characteristic of the human countenance, in opposition to that of the lower animals; and this will appear more evident on comparing those forms and proportions which distinguish each from the other; though in their busts and portraits of individuals, they seem to have copied correctly the models they had before them.

In viewing the human head in profile, it will be found that a line from the opening of the mouth, (the alveolar process of the jaws), and another from the same point to the projection of the chin, will form an angle so obtuse, as to deviate little from the straight line, owing to the prominence of the forehead and chin; this is called the facial angle; the eyes lie in the cavity formed by the projection of the forehead, the proportion between the face and the cranium is nearly equal, as a line drawn across the eyes divides the head into two equal parts, reckoning from the crown of the head to the base of the chin. In the heads of all the lower animals, on the contrary, the facial angle is very acute, the nose and forehead are flat, and fall back, and the eyes are very prominent; and the face, up to the beginning of the frontal bone at the middle of the orbit of the eye, (which forms the boundary between the face and cranium), will be found much larger, commonly two-thirds, than the space from this point to the crown of the head; and the fullness and protuberance of the chin, which forms so beautiful and striking a characteristic of the human countenance, entirely disappears, leaving nothing but an uninterrupted straight line from the gums to the angle of the jaws. This subject will be found more amply discussed in Professor Camper's treatise on the connection between the science of Anatomy and the arts of Drawing and Painting, from which the student will derive much useful information.

Besides the anatomy of the human body, which is so sure a guide in drawing the figure, the artist, who aims at truth in the representation of animals, will do well to pay some attention to the study of comparative anatomy, more particularly the mythology and osteology of such animals, domestic or otherwise, as occur most frequently to the painter in the exercise of his art. Notwithstanding the variety in the structure and organization of the lower animals, as adapted to the habits and modes of life peculiar to each, the analogy between these and man, (we speak more particularly of quadrupeds and birds,) is so great, that the knowledge of the anatomy of the human body will form a sure foundation for this other part of the science. Although the Dutch school has produced many artists eminent as painters of animals, such as Du Jardin, Berghem, Van de Velde, Bamboccio, Cuyp, Wovermans, and others, yet none of them seems to have studied with such minute attention the anatomy of animals as Paul Potter; these he has drawn with great truth, spirit, and intelligence; he sometimes, however, makes so ostentatious a display of his knowledge of the bones, as to give a character of leanness and poverty to his animals, ill suited to the richness and beauty of his landscape. Cuyp's great aim was rather a good general arrangement of his figures, as subservient to some brilliant effect of sunshine which he had in view, than any particular minuteness of details; accordingly his animals particularly have much colour, and well grouped, display none of that scientific drawing, which is so desirable, and which we admire so much in the works of Paul Potter, Du Jardin, and some others of that school.

Stubb's great work on the anatomy of the horse will afford the best assistance to the student in the investi-
The ancients, according to Vitruvius, divided the human body into eight heads, or ten faces. The face is reckoned from the top of the forehead at the root of the hairs, to the bottom of the chin; the head from the crown to the same place. In a well-proportioned man, whose arms are stretched out, the distance between the extremities of the fingers of the right and left hands, should be equal to his height, his figure therefore may be included in a square. The proportion of the female figure was formed about one face shorter than that of the male; but it differs from the male more in form than stature. The shoulders are narrower, more rounded and softened than in the male; the chest is more convex, the breasts more elevated, the abdomen more prominent, the loins longer, and the limbs proportionally shorter; the pelvis is broader, and consequently the thigh bones more distant from each other, and inclining inwards with a rapid slope as they descend. The feet and hands smaller, dimpled, and more delicately turned; and on the whole, the abrupt turnings and projections of the muscles, which, in the male, are the mark of his superior strength and energy, are, in the female, rounded and smoothed into lines of the utmost grace and delicacy.

We have extracted from the work called *I Princìpi del Disegno*, published at Rome by Volpato and Morgagni, the following measurements of the three principal statues of antiquity, which, for the sake of more easy comparison, we have reduced to a tabular form: they will give a more perfect idea of the proportions adopted by the ancients, and the distinctions between the male and female characters. In order to preserve uniformity in the measurements, the head of each figure is divided into twelve parts, and each part into six minutes.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Apollo</th>
<th>Venus</th>
<th>Hercules</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the beginning of the head to the root of the hairs</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>From the root of the hairs to the eyebrows, or beginning of the nose</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<tr>
<td>From the eyebrows to the end of the nose</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>From the end of the nose to the bottom of the chin</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>From the chin to the articulation of the clavicle with the sternum</td>
<td>5</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>From the clavicle to the end of the breast</td>
<td>9</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>From the end of the breast to the middle of the umbilicus</td>
<td>10</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>From the umbilicus to the symphysis pubis</td>
<td>7</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>From the symphysis pubis to the middle of the patella</td>
<td>11</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>From the middle of the patella to the beginning of the flank</td>
<td>23</td>
<td>21</td>
<td>30</td>
</tr>
<tr>
<td>From the same to the swell of the foot</td>
<td>23</td>
<td>21</td>
<td>30</td>
</tr>
<tr>
<td>From the swell of the foot to the end of the figure, or to the ground</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>From the patella to the ground</td>
<td>25</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>From the patella to the end of the heel of the right leg</td>
<td>14</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>The length of the sole of the foot</td>
<td>15</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>The highest part of the foot from the ground</td>
<td>3</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>From the instep to the end of the toes</td>
<td>4</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>From the clavicle or collar bone to the beginning of the deltoid muscle</td>
<td>9</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>The length of the whole clavicle on the right side</td>
<td>9</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>From the clavicle to the nipple</td>
<td>10</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>From one end of the breasts to the other</td>
<td>15</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>The greatest breadth of the trunk, taken a little below the beginning of the thorax</td>
<td>18</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>The breadth of the trunk from the end of the breast</td>
<td>15</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>The narrowest part of the same, taken at the beginning of the flank</td>
<td>15</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>The greatest breadth of the osa ili, where the flanks project most</td>
<td>16</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>From the highest part of the deltoid muscle to the end of the biceps</td>
<td>17</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>From the beginning of the os humeri to the cubit</td>
<td>17</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>From the end of the biceps to the beginning of the hand</td>
<td>16</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>The greatest breadth of the fore-arm in front</td>
<td>4</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>The greatest breadth of the arm in front</td>
<td>5</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Breadth of the pulse of the arm in front</td>
<td>10</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The greatest breadth from one trochanter to the other</td>
<td>17</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>The greatest breadth of the thigh in front</td>
<td>19</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>The greatest breadth of the left thigh</td>
<td>17</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>The greatest breadth of the knee opposite the middle of the patella</td>
<td>5</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>The greatest breadth of the calf of the leg</td>
<td>6</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>The greatest breadth between the inner and outer ankle</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>The narrowest part of the foot</td>
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<td>3</td>
<td>3</td>
</tr>
<tr>
<td>The broadest part of the same</td>
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<td>0</td>
<td>5</td>
</tr>
<tr>
<td>From the last vertebra of the neck to the lower part of the os sacrum</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>From the end of the os sacrum to the end of the glutaeus</td>
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<td>0</td>
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</tr>
<tr>
<td>From the end of the glutaeus to the beginning of the gastrocnemius muscle</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>From the beginning of the gastrocnemius to the end of the figure</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
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</table>
The theoretical parts of the art, which are equally applicable to all the branches of it, as far as they respectively go, from sublime allegory to the humble departments of flowers and butterflies, will be found, in what relates to the form of objects, in the preceding article; and the great principles of chiaroscuro and colouring, will be more clearly elucidated under the article Painting: We shall here, therefore, consider drawing only in a practical point of view, by treating of the processes and operations employed in the various parts of it.

As the principal and most distinguishing attributes of most objects are contained in their form, the foundation of every branch of this part of the art is correctness of outline, without which the finest colouring and most laborious finishing will fail to convey the true character of the object to be represented.

In copying any object, or set of objects, whether from nature or from a picture, it is evident that, on whatever scale it is performed, whether larger or smaller than the original, the proportion of the parts to the whole, and of one object to another, in the various relations of length, breadth, height, and distance, is the basis of correctness of form and true delineation.

Whatever department of the art may be the student's ultimate aim, the habits of correctness, and accuracy of eye and hand, which are desirable in all of them, will be best acquired by careful practice in drawing the human figure, whether from prints, drawings, or from plaster casts. As the gentle undulations and delicate inflexions of form, of which the human figure is in a most peculiar manner composed, demand the utmost attention, and as the slightest inaccuracy instantly discovers itself, by distorting, or at least changing, the character of the object, his eye will speedily acquire that facility of minute discrimination, which will extend itself to every species of objects, and render every thing easy which he may afterwards attempt, whether animals, the ramification or foliage of trees, buildings, mountains, &c.

Although it is usually recommended that the student begin with detached parts of the human figure, such as eyes, noses, hands, feet, and the like, and that when he has acquired tolerable facility in this, he may proceed to whole figures, yet he will derive greater advantage from beginning these at once. The figure ought of course to be simplified in its details as much as possible, and, that it may be the more easily comprehended, a certain formality in the attitude may at first be advisable, which may afterwards be gradually varied, according to the progress of the student. He will thus acquire sufficient accuracy in the smaller parts; and, what is more difficult, a correctness and facility in arranging and disposing the larger masses of the several members, according to their various proportions and relations to each other.

In beginning an outline, the general proportions of the larger parts should be first blocked out, if we may use the expression; and these may be considered rather as to their situation than their form. When this has been done with sufficient accuracy, he will then gradually descend to the more minute parts, till the whole is completed. The advantage of this method is sufficiently obvious; for if the student begin with the more minute parts at once, finishing his outline as he goes on, he will not proceed with the same certainty; the parts will not be so well put together; and when a correction is to be made in the general inclination of an arm, a leg, or the trunk, all the time and attention that he has bestowed on the minutiae are entirely thrown away.

In marking out the leading lines and points of the object to be copied, he should begin by assuming the size of some part of the figure; the head, for instance, to which all the other parts are to be proportioned, according to their relative magnitudes, whether larger or smaller; and a few of the most prominent points should be carefully marked in their true proportions, according to their respective distances and bearings, whether lying horizontally, obliquely, or perpendicularly with each other.

In order to assist the eye in placing the various parts in their proper, relative, perpendicular situations, a small plummet is sometimes used; but it is better to habituate the eye to lead itself from one point to another in any given direction, without any other auxiliary than the correctness which careful practice may have given it.

With regard to the style in which the lines ought to be executed, the student ought to aim at something further than a correct, neat, and distinct outline, such as may be best suited to the form and surface of the original; as freedom and boldness of execution, which dazzle and mislead the ignorant, are qualities which practice only can give, and, when sought after, are too apt to lead to the greatest of all defects, affectation and manner.

It has often been recommended to beginners, and that by respectable authority, in order to enable them to turn their hand, to practise the drawing of straight, curved, and parallel lines, without reference to the delineation of any particular object; but all this may be as easily acquired at the same time that the learner is improving the correctness of his eye, by the representation of objects wherein every species of lines occur; and no one is better calculated for this purpose than the human figure.

When the student has attained considerable proficiency in outline, he may proceed to the shading of his figures, which may be done with black lead, black or red chalk, or Indian ink, bistre, sepia, or the like. But black chalk is, upon the whole, best adapted to this purpose. There are several ways of using the black chalk, viz. by the method called hatching, which is performed by parallel lines crossing each other at certain angles, according to the nature of the shadow and form of the object represented, which is the same principle as that on which stroke engravings are executed: as also by smooth shadows produced by the chalk, without the appearance of any lines. Of this last there are many varieties, which we shall presently notice. The first mentioned of these methods, which, when skilfully executed, has indeed a very good effect, is not to be recommended to the painter, as the laying the lines, as the engravers call it, is so difficult and so essential a part of this mode of working, that the student is apt, in attending to this subordinate part, this language in which he is expressing himself, to neglect the subject of which he is treating. To the young engraver, it may, however, be useful in assisting him in the practice of the mechanism of his art.
The outline being carefully made out in black chalk, a little of the scrapings of the chalk should be rubbed over all the shadows with a stump; an instrument made of chamois leather, rolled up tightly in a cylindrical form, and cut at both ends to a point. This performs the operation with great smoothness, and makes an excellent ground for the finishing, which is done by working up the shades to the requisite depth with the point of the chalk.

The lights must be put on with white chalk, and blended carefully into the middle tint, (the colour of the paper,) by a stump kept for the purpose; and the greatest care must be taken to keep the black and white chalk from coming into contact, as their meeting will produce a disagreeable and unharmonious colour.

In drawing on white paper, the outline should be made out with the chalk, and the shadows rubbed in with a stump, and wrought up to the proper depth, as already mentioned, till the shadow be sufficiently smooth. Any errors in either the outline or finishing may be corrected by rubbing them out with the crumb of a new loaf, squeezed together into a convenient shape. This method is much more tedious and difficult than when it is performed on tinted paper, as it requires infinite labour to give sufficient smoothness and delicacy to the surface. Sometimes a middle tint is formed by the scrapings of chalk laid on with the stump over the whole paper, and the lights taken out entirely with the bread. This method, when well executed, has a beautiful effect; but the time and practice necessary to do it well, render it totally unfit for an unexperienced hand.

In drawing in Indian ink, the outline should be made out with black lead, which in this case is preferable to chalk. The great masses of shadow must be laid in first, and, beginning with the tints much lighter than is wanted, smoothing them in with a wet hair pencil, and repeating the process till the shades be brought up to their proper depth; taking care that each shade be perfectly dry before another is put over it.

For slighter sketches, where boldness and freedom of outline are principally aimed at, as in studies for the composition of larger works, a pen was much employed for the outline by the old masters, particularly by those of the Italian schools, and slightly shaded with the hair pencil, with bistre, sepia, or the like. The drawings in this way of Leonardo da Vinci, M. Angelo, Raffaello, the Carracci, Parmeggiano, and others, are deservedly much esteemed, and frequently sell at very high prices. Of all these methods which we have mentioned, that which we would particularly recommend, as combining utility and expedition, is that of the black and white chalk upon tinted paper. The tint of the paper should be light, that the black chalk may be seen distinctly upon it, and, in order to avoid the coldness and harshness which paper of a dark shade always gives to light put in with white chalk, or any similar substance. In making any correction, a piece of new bread is preferable to Indian rubber; and if any greasiness appear by the too frequent use of the bread, so as to prevent the paper from receiving the chalk readily, warming the paper at the fire will in a great measure remove it.

The student should at first occupy himself for some time in copying from drawings only, and when he has acquired, in some degree, the management of his materials, and a knowledge of the method of expressing himself, he will do well to begin to draw from good casts from the antique, and after that to go to nature; but in this stage of his progress, he will go little way without the assistance of anatomy, the use and necessity of which we have already most anxiously inculcated in the preceding article.

In the management of light and shadow, whether as applied to the human figure, or to any other subject, there is perhaps no one circumstance so conducive both to truth and beauty of representation, as "breadth of effect." In the language of art, breadth is opposed to what is called spotness. Breadth implies, that the lights and shades be arranged in large and broad masses. The separation of the lights and shades into many small parts, leads to the unpleasing effect of spotness. Both of these appearances are often exhibited in nature. But in every instance, the one is delightful, the other is tending to the sense; the former is essential to beauty and grandeur, the latter, unavoidably, is productive of littleness. Its great principles will be more fully treated of under the head Chiari occulto, (see Paintiko;) but we shall, in a summary way, take notice here of as much as is connected with the drawing of single figures.

In looking at a statue or plaster cast, with the light coming on it from one point, the delicate and almost imperceptible transition from light to dark are very obvious; every feature has the most complete relief, even on the parts where the shadow is most delicate, as well as on the dark side of the figure, while the shadows on the different parts of the dark side are sufficiently distinct without harshness; and throughout the whole, nothing obstructs itself to the eye to interrupt the general roundness and repose, or, as it is called in technical language, to cut it up. These delicate interlaced and gradations of shadow, on the light parts of the face and body, which in reality are little removed from the brightness or clear light, being so well defined in the model, are apt to be mistaken by the inexperienced student, and to be made so dark as to leave him no power of giving, with his chalk, the necessary depth of shadow, and consequently roundness to the whole; he must therefore attentively consider the effect of contrast, and endeavour to distinguish what is in itself light or dark, from what may appear so from its being placed near to tints of an opposite character: in this he will derive much assistance from looking frequently at his model with his eyes half shut, or through a Claude Lorraine glass, (a lens of a very dark colour,) or even a piece of window-glass, blackened with the smoke of a candle, as he will by this means lose sight of the particular forms of the more minute parts, and he will see only the great masses of light and shade, and thus be more accurately discriminate between what is light, middle tint, or pure shadow, the right management of which constitutes so great a source of beauty in the human figure, which, from the rotundity of its form, displays so fine an illustration of this principle. The judicious introduction of the reflected light, affords the greatest assistance in giving accuracy and distinctness to the details of those parts of the figure which are in shade, and likewise in giving the requisite roundness and delicacy. These reflections are always to be seen in nature to a certain extent; but when they do not appear with sufficient strength, they may be assisted by setting up a sheet of white paper, or the like, at such a height and distance from the model as may be best suited to the effect required.

In drawing from nature, or from the plaster cast, the model should in general be placed, with regard to the light, in such a situation, that at least two-thirds of the figure be illuminated; and when the light comes in from above, it has a still better effect; but this position of the
figure will be of course modified, according to the taste of the artist, or the intention he may have in view. In order to have a good view of the figure, it should never be nearer the eye than twice its own length. Those general precepts which we have given above for drawing the figure, apply to a certain extent to all visible objects, varying and modifying the style of outline and shading in the way that seems best calculated to express the qualities of form and surface of objects he is imitating; and this talent will be best acquired, by the attentive observation and comparison of nature with the works of other artists.

In the drawing of landscape, the same process in the outline must be adopted as in the figure or other objects; that is to say, to begin with those great lines which bound the principal masses, and from these to proceed to the smaller ones; but as the various objects which it is the province of landscape painting to represent, differ most essentially from the human figure, and from each other, a separate style of outline must be adopted for each. A tree, for instance, as it consists of many small parts, which it is impossible for any mere outline to represent, and as these parts vary considerably in their appearance, according to their distance and their condition with regard to light and shade, such a mode of imitation must be adopted as will best express, in a general way, those appearances; whilst, in those near the spectator, even the character, both of the foliage and ramifications of the species to which it belongs, whether oak, ash, beech, &c. must be attended to.

As the forms of hills are distinct and well defined, they do not admit of that latitude of generalization which must necessarily be allowed in the drawing of trees; every feature must be marked distinctly, and with almost the same accuracy, that we have inculcated in drawing the figure. Lines, besides what is sufficient to express the exact contour of the object, should likewise be touched here and there over the whole object, when near enough to be seen distinctly, in order to convey a true idea of its acclivity and of its surface, whether broken by precipices, or covered with wood, and even expressing the character and position of the strata of which it may be composed, when visible. The necessity of this cannot be too much pressed, as it is too frequently the practice, by neglecting it, to give a form and character so different from the original, as to render it hardly recognizable.

In drawing architecture, (we speak here not of geometrical elevations and plans, but of architecture as forming a part of landscape painting,) when the surface is smooth, the outline must be executed with a clean straight line, and a ruler may even be occasionally employed to advantage; great attention should be paid to the squaring and precision of the turnings in the corners, doors, windows, &c.; and on the parts where the shadow comes, the objects may be marked with a firm dark outline.

In drawing any set of objects, which are all of the same size and height, such as a range of windows, arches, or columns, in order to keep them in their proper places, lines should be drawn as light as possible, according to their perspective inclination, which will include the upper and lower part of them all; and before making them out individually, these lines must be divided, according to the number and situation of the objects, whatever they may be. By this means, the position and magnitude of each will be accurately found; much trouble in altering and correcting will thus be saved; and the occult lines will be rubbed out as soon as the delineation of the several objects is completed.

Without a knowledge of the rules of linear perspective, nothing in this way can be well done, as nothing in painting occurs which is not subject to the influence of its laws; as the beauty and truth of such objects, besides the spirit and character of the outline, depend much on the proper inclination of the lines of the various objects, according to their convergence to their respective vanishing points; and although much careful practice may give a general correctness of perception to the eye, which may prevent gross mistakes, yet as the principles are wanting which give certainty and decision, perpetual errors will intrude themselves; and to the more intelligent critic, the artist's ignorance of this indispensable requisite of his art will instantly display itself.

We shall now proceed to give a few hints on some of the more minute parts of the practice of outlining. These, to some, may perhaps appear trifling and impertinent; but as method is most essential in every mechanical art, and mere delineation is nothing else, we are convinced that the student will readily assent to their utility; for, though, by experience and practice, he will ultimately find them out himself, yet as they are not so obvious at first, his progress will be much accelerated by their communication.

In drawing arches, or other similar objects, whether of a circular or elliptical form, the vertical lines on which they rest, representing their piers, should first be drawn; the points from which they spring at both sides, and the highest point at the key-stone, should then be marked; and before these points are connected by their proper lines, he will be able to form an idea of the appearance and proportion of the part; and he will proceed with his work with less doubt and uncertainty; he will likewise attend to the radiated appearance of the joints of the stones that compose the arch, taking care that they converge to the centre of the circle of which it is formed: this ought to be particularly attended to; and, by neglect of this rule, younger students are apt to betray themselves in drawing objects of this sort. When any line, whether straight or curve, lies in an oblique direction, in order to assist his eye in judging of the angle of its inclination, he ought to mark points for both ends of that line before drawing it; and in objects wherein an approximation to the figure of an isosceles triangle occurs, as in the gable of a house or the pediment of a portico, in order to preserve the necessary uniformity of the sides, he must scrupulously attend to the situation of the apex of the angle, considered both with regard to its height, and its relation to the perpendicular lines, at both ends, on which it rests. In delineating ruins, the lines must be executed in a more ragged and uneven style, than in buildings of a smoother character; making out carefully the forms of the several parts, and giving that precision and firmness in all their details, which instantly convince the spectator of the intelligence of the draftsman, and the truth and accuracy of his work.

In making an outline, the mode of practice adopted by many, is to divide the edges of the drawing to be copied, into any number of equal parts, like the degrees of latitude and longitude in a map. The points at the base of the drawing will give the situation of the perpendicular lines, and those on the sides their heights, and vice versa, the places of the horizontal lines will be found by the points in the sides, and their lengths by those on the base; but as this method is not appli-
Cable to any extent to drawing from nature, to which every practical device ought to have a reference, it is only to be recommended to the beginner, who at first may find some advantage from it.

In drawing from nature, it is necessary to begin by fixing the boundaries of each side, which, in general, ought not to extend farther than what can be conveniently seen at one view, without turning the head, subtending an angle of about 60 degrees. He will thus be able to regulate the proportion and quantity of the subject he means to introduce, according to the size of his paper; by dividing between those boundaries, and observing what lines or objects coincide with those points and their subdivisions, he will easily find their places and relative distances; and the heights of the several objects will be found, by proportioning them to their breadth, or by regulating them by the situation of any other object which may be on the same level; for this purpose it will be found of great service to fix, as soon as possible, the height of some long horizontal line, the horizon itself, when it occurs, and to adapt the height of the several objects, whether above or below this line, according to the distance of the point required from it, compared with its own breadth, or that of any other object already marked. When the places of the several parts are thus found, for their forms in this first stage of the process are entirely out of the question, the details may be entered into, always giving the preference to the larger parts, and keeping in view what has been already said about the methods to be adopted in making out the various minutiae.

There is no part of landscape painting more neglected in general practice, and none where the artist has a better opportunity of displaying his taste and correctness, than in representing the beauty and variety which nature exhibits in the foliage of trees. This will be apparent, if we consider the works of Claude Lorrain, whether in his pictures or etchings, or even in the fine engravings after him by Vivares and others, we will mark that grace, beauty, and truth, which are no where else to be found, and which place him in this respect above all praise, and sufficiently show what may be done by the careful imitation of nature, guided by sound judgment and good taste; while the great inferiority in this point, from whatever cause it may have arisen, of his pupil Swanevelt, and many of the most eminent landscape painters, sufficiently shows both the difficulty and high importance of this part of the art.

The study of architecture, which, in itself considered, is of the greatest importance to the landscape painter, from the high tone and elevated character which its judicious introduction gives to his works, is likewise a useful auxiliary, in enabling him to give precision and character to the angles and turnings of his buildings, which, even to the mere woman of views, and the younger practitioner, are qualities of some consideration, and well worth the trouble of acquiring.

When the student has attained a sufficient accuracy of eye and facility of outline, he may proceed to the shading of his drawings, either with black lead or black chalk. As those delicate transitions and modulations of light and shadow, which are so necessary to the correct representation of the human figure, do not occur in landscapes, he may perform this operation with more boldness and freedom. Instead of that scrupulous attention to the smoothness of his surface, by blending into one tender and even tint the touches by which his shadows are produced, the lines may be kept separate or not, according to the depth of shadow or effect which the quality of surface may require. Particular rules for executing the lines will not be of much use, as copying good drawings, and observing the manner practised by the old masters in their etchings, will afford more instruction in this point than all that can be said on the subject. In general, it may be said, that the lines which compose the shadows should lie in the direction of the object itself, that is to say, that in a perpendicular wall, or similar object, the lines should be perpendicular; in an inclined object, the lines should incline; in cylindrical or spherical objects, a tower, a column, or a ball, they should take a curve direction. Perpendicular objects may also be shaded with horizontal lines, and that either wholly, or, for the sake of greater richness of effect, alternately with perpendicular ones. When the sides of an object are so situated with respect to the point of sight, that, instead of being horizontal, they converge to their several vanishing points, the lines of the shading will follow the same direction as the objects themselves. In shading buildings, or indeed any object wherein accuracy and precision are so essential, of whatever scale it may be, no more of a shade should be attempted than can be conveniently done by the motion of the fingers and thumb, while the hand rests steadily on the paper; and the joinings of those parts, which must be done with a careful freedom, if we may use the expression, will give a certain degree of richness and variety to the appearance, which could not be so well expressed in any other way; but in such objects as have not a form so well defined, particularly when they are large, and require a smooth and flat tint, such as the sky, hills, &c. the shades may be done by the motion of the hand or the wrist, keeping the arm steady, and with an oblique line, which is most convenient for this position of the hand. Plate CXXXVI. will illustrate further what has been said in this branch of the practice of drawing.

Fig. 1. represents the gable of a house, so placed with regard to the spectator, (that is parallel to the ground line,) as not to be affected in its form by its perspective situation. The vertical lines a, b, are first drawn, and the points at a and b, whereon the roof is to be placed, which are both of the same height, are marked in their proper places, in order to give the two sides of the roof the same degree of inclination. The space between a and b is divided into two equal parts, which gives the point over which the apex of the angle is to be placed.

Fig. 2. is the same object, seen in perspective. The points a and b, instead of being of the same height as in the other figure, converge to a vanishing point, so that the two portions of the occult line a, b, from a to c, and from b to c, though in themselves equal to each other, are now by their perspective situation considerably changed, both in their relative height and distance from each other. The point b is lower than a, and the space between b and c being further off, and consequently seen under a smaller angle, is smaller than that from a to c. The perspective centre c will be found by producing the vertical lines a and b to any height, as at e, from which point a vertical line will be drawn to the vanishing point f. The intersection of the line ef, at the point g, will give the line eg of the same perspective length, and parallel to ab, which will represent two sides of an oblong square; the vertical lines ae and bg will give the remaining two. In order to find the centre of the line ab, over which the apex of the angle of the roof is to be placed, diagonal lines ga, and gb are to be drawn, the intersection of which will give the point h, through which the vertical line lc will be drawn, which divdes the line...
a b into two equal parts c, as required. On the line
P on whatever height, at a, k or l, the place of the
corner of the pediment will be marked, and the lines i a,
i b, k a, b or a, b, l, will be drawn according to the height
required.

Fig. 18. is an example of the method of shading objects,
the surfaces of which are not so regular, the sky, trees,
hills, &c. The lines are here zig-zag, their distances are
kept equal, and they may be crossed to increase the
depth of the shadows.

The student will derive much advantage in this
point, from the examination of etchings of the Italian
and Dutch landscape painters, such as Claude Lorraine,
Canalette, Du Jardin, Rembrandt, Both, Ruysdael, and
others, which will conduct him on the right path; and
will sufficiently warn him to avoid the low, vague, and
unscientific style of Moreland, and his followers, the
makers of drawing books, who have been long so success-
ful in corrupting the taste of the amateurs of land-
scape.

In drawing with Indian ink, bistre, or any other si-
lar colour, always presupposing a correct and well
defined outline, the large shadows will be laid in first,
marking out the general effect or chiaroscuro of the whole;
the shadows of the smaller objects will follow;
and the finishing touches will be given to each part,
according to the strength of colour and style of hand-
ing, which the situation and character of each may re-
quire. In laying a large shade, there is considerable
difficulty to the beginner, in keeping it smooth and free
from those marks and stains, which arise from stopping
in the middle of the operation, or working with too
small a quantity of colour in the pencil, and thereby
allowing the edge of it to get dry before it be finished:
this may be avoided by beginning at the left side
of the part to be wrought upon, going regularly on with
a full pencil, and leaving no part so long as to give it
time to dry at the edge. The pencil should be of a size
proportioned to the space to be covered; and the shade
should be laid on as smooth and equal as possible, with-
out leaving any more of the tint than is sufficient to
cover it. This ought to be particularly attended to in
skies, where any defect of this sort is so conspicuous
and irreremediable.

In sketching from nature, the most essential requi-
sites of which are characteristic, spirited, and cor-
cet delineation, and a slight but expressive mode of
shading: the outline is often done with a pen, and this,
either with Indian ink, or a brown colour; this last,
when the shading is done with Indian ink, gives a fine
effect when applied to the sketch. A solution in oil of
terpenine, of the bitumen called asphaltum, is sometimes
used in this way; and in those subjects where bold-
ness and freedom, rather than minuteness of de-
tail, are required, such as large trees, rocks, &c.
it has a fine effect. The paper should be rather of
a rough and absorbent quality, such as the finer sort
of cartridge paper, as it prevents blotting, to which this
solution has a great tendency: it should be kept in a
phial, and the pen dipped in it when wanted.

The tinted paper already mentioned, is very useful in
slighter works, whether sketches from nature, or those
studies for the composition or effect of larger pictures;
as the chiaroscuro may be made out, with great ease
and rapidity, either with black chalk or Indian ink,
and the lights put in with white chalk, or with perma-
nent white, put on with a hair pencil. This is the oxide
of zinc, ground in the usual way, and mixed with the
mucilage of gum arabic; it is sold in the shops in cakes,
and is infinitely preferable to white lead, or flower white,
which, from their tendency to return to the metallic
state, and to become black, are totally unfit for use in
drawing in water colours. In this way, those brilliant
and transitory effects of sunshine, which are so striking
in nature, and give such interest to a picture, may be produced with the utmost ease and delicacy.

The art of drawing in water colours, which, till within these few years, had never been considered in any other light than as an expeditious method of making sketches slight, has been recently carried to the greatest perfection by the landscape painters of the English school.

The method that was followed in its beginning, was to make out the effect and finishing by what was called a neutral tint, and afterwards to give each object its proper colour and depth, by washes of the several tints over the original one. This mode, though not adapted to give that strength, solidity, and variety, which the recent improvements of our contemporary artists have shown that drawing in water colour is susceptible; yet as the process is more simple than any other, it is on the whole better calculated for beginners, who, when they have acquired sufficient facility in it, and knowledge of their materials, may extend their researches to the other methods, which we shall afterwards take notice of.

The neutral tint, which each artist made up, like every other tint, in his own way, was by some composed of blue, lake, and gamboge; blue, lake, and Indian ink; or blue, lake, and sepia. The student will begin by a wash of the grey over the distance, leaving out those parts which are quite light; and as a more soft and delicate effect will be produced by repeating the process several times than by doing it at once, the tint will be made lighter at first than the effect intended. In this manner, every part of the work, from the most remote distance to the face ground, will be done; with this difference, that the proportions of the various colours composing the neutral tint will be altered, according to the distance of the several objects. Thus the lake and blue, which produce the aerial tones, will be increased in the distant objects, altering the tint from a coolish grey for the distant to somewhat of a warm brown for the nearer objects; and the proportion of the sepia, umber, or whatever it may be, will be greater for the face ground objects, leaving the paper untouched in every part where clear light is required. When the broad shadows have been thus laid in, and the general effect of the chiaroscuro produced over the whole picture, the more minute parts will be made out by darker touches of the same tint, of which each shadow is composed.

The sky.

The student will next begin to the colouring of the sky. The blue will be composed of Indigo, to which a small quantity of lake will be added; and the tint of the clouds will be made up of blue and lake, which will be modified by the addition of madder brown, sepia, light red, &c. according to the effect intended. In laying in a flat tint of blue, or any other colour where smoothness and equality of surface is desirable, the paper should be dampened with clean water laid on with a broad thin brush, and as much of the water taken off by pressing the paper with a clean towel, or a piece of blotting paper, which will leave it in a state sufficiently damp for the purpose. This will be found of great service, particularly when a gradient from a darkish to a lighter blue, or, as in morning or evening, from blue to a warm yellow, orange, or red colour, in the horizon, is required. When these colours are fixed by the drying of the paper, if the warm tint is not sufficiently strong, it may be increased to any depth, by another wash of the same colour, which may be blended into the blue with a little clean water. The clouds and whole drawing may likewise get a wash of the same, and the necessary variety of blue on their different parts may be afterwards given.

The greens will be made up of sepia and gamboge, and may be diversified at pleasure, according to the tint of the several objects, by the addition of indigo, brown pink, or burnt terra di sienna. The buildings, rocks, trunks of trees, &c. may be done with a light tint of burnt umber, and those more distant with burnt sienna, which will form a ground for any variety of cold or warm colour which it may be necessary to put over them; and these may be varied to any extent, by tints composed of blue, umber, lake, burnt sienna, sepia, yellow ochre, and the like.

As, by the repeated washing of the several tints over the grey, the sharpness of the several parts will be considerably injured, it will now be necessary to retouch, with great care and delicacy, any part that may be defective in this respect: the distance with warm or cool shades of grey, according as it may be wanted, and the face ground with brown, made up with sepia, and perhaps the addition of lake and blue, which will complete the process. But in this stage of the process, care must be taken to avoid cutting up this effect by a dark and harsh mode of touching.

In painting a sky, it is often desirable to give more sharpness and decision to the forms of the lights than the ordinary processes of merely leaving them out permit, such as on the edges of the clouds, the form of the sun or moon when they occur, or the rays of light bursting from behind a cloud; accordingly various substances have, at different times, been used to stop up the lights, as in aquatinta engravings, and prevent the tints from adhering to the part of the paper where it has been put on; and when they were finished, to take off the substance employed, leaving the paper perfectly free from any tinge of the colour: for this purpose, the yolk of eggs, and compositions of white lead and olive oil, or white lead and mastic varnish have been used, the former of which may be taken off by Indian rubber or the crumb of bread, and the latter with the oil of turpentine, or spirit of wine rubbed over them with a brush. But of all the substances that have been used for this purpose, there is nothing that unites so well the advantages of utility and convenience, as pipe clay scraped upon a plate and mixed up with water to a due consistency; the touches being put in with this, by means of a hair pencil, and allowed to dry, the tints may be washed freely over it, and when rubbed with bread the lights will come out with the utmost sharpness, and will have more the appearance of being touched over with distemper or some opaque substance, than of any thing that water colour painting could be supposed capable of producing.

The preparation of the paper.

The proportions of water colour painting of great importance in water colour drawing. The best drawing paper, as it is manufactured, is totally unfit for finished drawings, from the smoothness of its surface: it must therefore be well dampened, and the polish taken off by rubbing it well with a wet sponge. By this means, the paper will acquire a degree of roughness and absorbency, which will afford great assistance in giving the necessary solidity and depth; which were qualities unknown to water colour drawing till this process of treating the paper was adopted.

Another method, which is next to that of the neutral tint in simplicity, is, to make up the shadows of distant objects with indigo and Indian red; of those that are nearer, with Indian ink; and the face ground with shades of Indian ink, and touched up in the minute parts with
sepia. Over these the tints of the different objects are put on, as already mentioned.

By mixing with the colours of the sky, and the grey tints of the distant shadows, a very small portion of permanent white, great dilution will be made to the solidity and apparent air of these parts. The quantity of white must be excessively small, and when in due proportion, will not be discovered by making any difference on the general appearance of the object, and these tints may be washed over as often as the effect may require; and this may even be practised both on the lights and shadows in every part of the drawing.

Sometimes a drawing is carried through its different stages without the use of any middle tint, by putting on the lights and shadows of the different objects at the same time; the lights, of course, of their proper colour, and the shadows composed of tints, wherein the colour of the object and the greyness of shadow are combined, and blending them into each other when wet; and these tints, both in light and shade, may be retouched with other tints, according to the variety and depth required in the several parts.

The practice of some artists, is to put repeated washes of the pure colours singly, making out every part with greater brightness than is intended, and then to wash down with grey or neutral tints each object, according to its relation to the whole; and these tints will be much improved by the addition of the smallest quantity of permanent white, as already mentioned.

Another method much practised, which has a good effect, is to lay over the different objects with the tints of their respective shadows, without leaving any light. The light will be afterwards taken out by putting on touches with clean water in a hair pencil, according to the form of the lights required, and rubbing the paper with soft bread till all the colour be entirely brought off the parts, and the lights will be put over on those parts where the tint of the shadow has been taken off. In this way, the lights of such objects which, from the complexity or peculiarity of the forms, it would be tedious and difficult to leave out, as in the foliage and ramification of a thin tree appearing light against a dark object, or in analogous cases, will be made with the greatest minuteness and precision. This may be extended to almost any object in any part of the picture; and in the foreground, in particular, the degree of roughness which it gives, (which is indeed a stumbling block to the ignorant,) is of most essential advantage, in giving a variety of surface in rocks, trunks of trees, &c.; and these tints may be washed over as often as necessary, till the parts are brought up to their proper tone, and if found not light enough, the process of wetting with the hair pencil, and rubbing with the bread, may be repeated as often as occasion may require. The lights on the surface of a piece of water, or the smoke of any distant fire, &c. will be much assisted by touching them up with permanent white.

When the drawing is found to have received too much local colour, thereby depriving it of the requisite effect of air, it will easily be brought down to the utmost delicacy of tint, by washing it over with a great quantity of water and a flat tin brush; taking care that all the colour that is disengaged from the paper be properly washed away, so that the brilliancy of the lights may not be injured by any of the dark colour. When the drawing is brought to a sufficient delicacy of effect, and has become perfectly dry, any deficiencies in sharpness of form or brightness of colour, may be supplied by retouching with the several colours.

The sponge is likewise an important auxiliary to a painter in this department of his art; as when any object has received a tone of colour, or even a form which he would wish to change, he may proceed with the wet sponge till he has got it sufficiently lightened, or even, if necessary, entirely taken out; and this will be no detriment to the general appearance of his drawing, as the paper is roughened already, as directed above, as much as it can be: it is obvious, however, that unless the paper be of considerable thickness, it will not admit the repetition of this process very frequently.

When the shadows of any objects, more particularly in the distance, have acquired too great a degree of brightness, it may sometimes be reduced by a method, the efficacy of which would not, à priori, be suspected; namely, by a thin wash of yellow ochre over the part, and sometimes a very thin wash of permanent white, or even, in certain circumstances, of pipe clay, will have the same effect.

We have already elsewhere cautioned the painter against the use of white lead, in any shape; as, from its opacity, and the blackness that it in a very short time acquires, it is altogether unfit for water-colour drawing.

In making out the effect of the reflections of objects in water, (always presupposing the knowledge of perspective necessary, to give each object its proper form and situation,) in order to represent the effect of softness and delicacy, so beautiful in nature, produced by the blending of the tints of one object into those of another; the paper should be damp all over the part to be wrought upon, in the manner already prescribed for doing a sky; and the broad masses of colour, according to the tint required for each object, will be laid on. The dampness of the paper, aided by the roughness of its surface, will give a softness and liquidity to the water, which could not be produced in any other way; and this process may be repeated when it has dried, as often as expedient, till the necessary effect be produced.

On the foreground, when a few touches of a very dark colour are required, indigo, and a little lake, will form a tint of the deepest tone possible, which, however, must be used with great caution, in order to avoid harshness.

As coldness is one of the most disagreeable defects that a picture can have, it will always be advisable to paint on rather a warm key; and this, when carried to any excess, may be much more easily corrected, by the introduction of a few cool greys in the shadows, than to give any appearance of warmth when the effect has got into the opposite extreme. This coolness will be best given, by a mixture of madder, lake, and indigo; and a very small quantity of this tint will be sufficient for the purpose.

We have made no mention of Prussian blue, which though a more brilliant colour than indigo, is not so well adapted, and has indeed lately been almost totally expelled from water-colour drawing. There is one serious disadvantage to which it is subject, namely, that in the grey already mentioned, made up of blue and Indian red, if the Prussian blue were used instead of indigo, the action of light upon it would soon discharge all the blue, and leave nothing but the colour of the red. This ought to be most particularly attended to, as in a few days the whole tone of the drawing would be completely changed.

The paper, before beginning to work on it at all, should be fixed on a drawing board, and made as flat as poss-
DRAWING.

Distemper, or body colour.

Besides the water-colour drawing which we have just treated of, there is another which is called distemper, or en détrempe, body colour, which differs from the transparent water colour in this, that, instead of putting on the colours in thin washes, one over the other, and diluting them with water, the middle tints are mixed up to the oil, and put on in thick opaque masses, lightened by adding white, and the lights and shadows touched on them till the effect required is produced, in the manner of oil colours. This method was much practised by the Italian and French landscape painters, more particularly those who painted architectural subjects and theatrical scenery.

But as few of the colours withstand, in this way, the action of heat, and as the surfaces are also easily damaged, it is best fitted for ornamental purposes, such as the decorations of rooms and theatrical scenery; particularly as, having none of the gloss which renders oil painting so marvellous for this purpose, it may be seen equally well in whatever direction the light may come upon it. The pigments commonly made use of in distemper painting, are fine chalk, zinc white, yellow ochre, Dutch pink, gamboge, raw and burnt sienna, light red, burnt umber, lakes, and indigo; to which number may be added, almost all those colours that are in general use, either for painting oil or water. They are to be ground up with water, and wrought with size.

Drawings in this way are commonly done on paste-board, made of two or three plies of paper, sometimes of paper pasted down on linen strained in a frame, and for theatrical scenery of strong coarse canvass. Paper that has rather a rough surface, and has in some degree what is called a tooth, is best calculated for this purpose. When the outline is sufficiently marked, in order to give the necessary smoothness and finish to the sky, which ought to be done at once, as there is some risk in attempting to retouch a sky, the paper must be wet all over with a hair pencil, which will keep it sufficiently damp till the sky be finished. The blue for this purpose is indigo mixed with white, till it be of a light enough tint. Blue verditer is sometimes used. A beautiful grey will be produced by the mixture of indigo and burnt umber, lightened to the tint required by the addition of white; if it be too purple, a little yellow may be added. But the student, who must have some previous knowledge of the effect produced by different combinations of colour, will soon be able, without much advice, to mix up his tints in this way, as well as in oil or water colours. There is one disadvantage to which this method is exclusively subject, namely, that the colours when wet have a totally different appearance from what they have after they have dried; but this difficulty a little practice will soon remedy.

In painting architectural subjects, for which purpose distemper is well calculated, the painter has advantages which neither oil painting nor water colours possess; he can give a sharpness and precision to the most minute members, as the lights and shades of those objects which are composed of straight lines, such as cornices and other moldings, may be ruled with the square, the colour being put on either with a fine hair pencil, or, when great minuteness is required, with a steel ruling pen. In the sky and distant parts of the picture, in order to give the necessary effect of air, the middle tints must be made up to such a consistency as to cover the paper entirely; but in the nearer objects, where this is not required, the colours may be mixed up with a smaller proportion of white, and put on with thick and semi-transparent: this will give a depth to the tones of the shadows; take off that chalkiness which it is so difficult to avoid in distemper painting; and, in order to increase the depth and variety of tone in the foreground objects, so necessary to the good effect of every picture, the process called glazing, so well known to painters in oil, will be found a most useful assistant. Of glazing.

It consists in this, that when the middle tints and lights are put on with the opaque colour, and allowed to become dry, transparent washes of the same colour, water colour are put over them, according to the quality of tint and depth of shadow required. Thus the green will receive a great accession of strength, freshness, and brilliancy, by a thin transparent wash of gamboge and sepias, which may be altered or modified by the addition of any other transparent colours, such as lake, indigo, burnt terra di sienna, umber, or the like; and tints composed of the same colours, by varying their proportions, may be produced fitted for every sort of object. As the washing over any tint with another must necessarily more or less impair the sharpness and spirit of the touches, it may be wrought up to the proper strength and firmness by dark touches of any transparent tint, best suited to the colour of the object.

The size, which ought to be made of the best glue, should be of such a strength and consistency, as to be permanently fluid at the common temperature of the atmosphere, 60°; when much stronger than this, it gives darkness to the colours, and when weaker, does not bind them together, so as to prevent them from rubbing easily off.

The colours when ground are to be kept in pots; and to prevent their drying and becoming hard, and so requiring to be ground again, they must be kept constantly covered with water, and occasionally stirred up with a small piece of wood.

Sometimes drawings in distemper are varnished, which gives them very much the effect of oil painting: but the brilliancy of the lights is entirely destroyed by this; a defect for which the amazing depth, variety, and clearness of tone which the varnishing produces in the shadows, by no means compensate. By rejecting those pigments, the basis of which is chalk, such as English and Dutch pink, verditer, &c. and using only those which have a good body when ground in oil, the tone of the picture will not be so much lowered; but it does not seem possible to give a proper effect to a picture in this way, without touching it up with oil colours.

It has often been suspected, and that with great appearance of probability, that it was the practice of the great masters of the Venetian school, to lay in the ground work of their pictures in distemper; and, by glazing and touching them up with oil colour, to bring them up to that astonishing brilliancy which, with few exceptions, is to be found only in the productions of that school. (P. 4.)
DRAWING INSTRUMENTS.

Drawing instruments may be divided into several kinds: First, Those for drawing lines, as pens, pencils, crayons, and steel pens. 2d, Instruments for guiding or directing the above, as rulers for drawing straight or slightly curved lines, compasses for drawing circles, the elliptograph for drawing ellipses, and the geometrical pen for producing a great variety of curves. 3d, Those which are used for marking or setting out distances, or dividing them, as compasses and divided scales, sectors and protractors; also instruments for dividing circles and ellipses.

Case of Instruments.

It is customary with artists, whose operations are connected with mathematical designing, to provide themselves with a selection of drawing instruments, containing such as they find, by experience, are most frequently wanted, and best adapted to their particular purposes. What is called a complete case of mathematical drawing instruments, such as may be obtained at almost any shop, contains the following articles: A steel drawing pen, the handle of which unscrews, and has within it a sharp steel point, for the purpose of pricking centre points. A black-lead pencil, with a silver ferrule or top formed to the shape of the point of a knife, but made with a smooth blunt edge, for the purpose of scratching or tracing lines upon the paper: these lines are permanent, though not visible without particular examination. A pair of compasses for measuring distances. Another pair of compasses, of a larger size, for the same purpose, and also for drawing circles; to effect this, one of the legs is fitted in a socket, and fastened by a screw, to admit of removal for the purpose of applying other legs to it: these are, a steel pen leg, for the purpose of drawing circles in ink; a leg adapted to hold a piece of black-lead pencil, for describing circles in pencil; also a dotting leg, which is a small wheel, with several points, something resembling the rowel of a spur: it is fitted to revolve between two blades, like those of a steel pen, and these, in the same manner, formed out of the leg, which adapts to the compasses. The space between the blades being filled with Indian ink, and the wheel rolled upon the paper while the compasses turn round, its points make equidistant dots in the circle which the compasses describe; and as the points of the wheel pass through the drop of ink which is held between the upper part of the two blades of the instrument, they are successively replenished with ink. A small pair of bow-compasses: these are small compasses, with a pen leg permanently attached to them, so that it cannot be removed: they are useful to draw very minute circles. A sector, which is a scale containing many lines of mathematical divisions, which are very extensively useful for trigonometrical operations. A parallel ruler, for drawing straight lines parallel to each other. A plain scale, which has lines upon it graduated with equal divisions, of different values. Also a protractor, or semicircle, divided into degrees, for laying down angles. All these instruments are so well known, that it is needless to give a more minute explanation of them, particularly as those which are sold in such kind of cases are not made on the best construction, having many defects, which it has been the study of several artists to remedy.

Pencils.

In our observations on instruments, we shall begin with those which are employed for drawing lines; and of these, black-lead pencils come first to be mentioned. They should be of very pure lead, without any mixture of hard particles. The hardness of its substance should be adapted to the purpose for which they are to be used: for mathematical drawing, the lead should be hard, so that it will cut to a fine point, and preserve it sharp for a considerable time without sharpening, and at the same time it should mark with so little pressure, that it will not penetrate or indent the paper. The mark it makes should be quite superficial, that it may be totally obliterated by a light application of the Indian rubber. This is a very essential requisite in a pencil; for if the paper requires much rubbing to clean off the pencil marks, its surface will be injured, and prevent any good finishing or colouring upon it.

Some pencils are made by reducing the black lead to powder, and recomposing it by the admixture of some glutinous substance. By this means they separate the impurities from the lead, and make tolerable pencils; but these do not stand to so good a point as others made from solid lead, when the same is of the best quality. Messrs. Brookman and Langdon of London, (28, Russel Street, Bloomsbury,) have invented a process, by which they purify the lead, and produce pencils of any required quality. With respect to the hardness, these makers distinguish them by the following marks: HH, very hard, for engineer or shipbuilders' use; H, rather less hard, for architects, who require less accuracy, but more freedom for sketching in ornamental parts; F, fine drawing pencils, are of a middle degree of hardness—these are not intended for ruling lines, but for drawing figures, landscapes, &c.; B, black for shading, are rather soft lead; BB, extra black for deep shadowing; and BBB, are prepared as black as possible for shadows. All these marks are of a very superior kind, having the requisites we have enumerated for good pencils, particularly the HH, which stands to a point so long, that cutting the pencil with a knife two or three times in the course of a day's work will be sufficient. The point will frequently wear so as to draw rather a broad line; but it is better to restore the point by rubbing it on a piece of paper, and at the same time turning it round, than to attempt cutting it every time with the knife. For this purpose, a piece of the very finest glass, or emery paper, is very useful. The point so formed should not be too acute, or it may break.

Steel pens, for drawing lines in ink, are made in many different forms; but they all consist of two blades of steel, so fitted together that they have a tendency to spring open from each other. They have a screw, or equivalent contrivance, by which the points can be closed together to any required degree, leaving a small opening between their points, through which the ink flows down from the upper part, where a drop of it is retained. When the pen is used, it must be fairly applied to the edge of the ruler, and drawn along it, taking care to hold it so that both points touch the paper at once, or it will not draw an even line. It will act best if it is rather held in an inclined position, in the direction of its motions; it then leaves upon the paper a breadth of ink equal to the opening between the points, and this may at pleasure be increased or diminished. The points of the pen should be rather round, that they may not penetrate the paper; but in the thickness,
they should be quite sharp at the edge, otherwise they will not make a regular line. Fig. 24, is a very good kind of steel pen, consisting of two steel blades, put together by a rivet at \( a \), and secured by a brass or silver cap, screwed upon the upper end, where the extremities of both blades being laid together, are cut into one screw, as shown at \( n \), Fig. 25. The lower part of the blades has a milled screw \( d \), which draws them together, to adjust the distance of the points \( e \). When the pen requires sharpening, the screw \( d \) is taken out, the cap \( b \) screwed off, and then the two blades may be opened out like scissors, on the centre rivet \( a \), as shown in Fig. 25, to expose the inside surfaces of the points \( e \). The points of all pens should be hardened and tempered; but they will in time grow blunt at the edges, by constant use, and must then be repaired, by rubbing them upon a hone to sharpen the edges again. In doing this, great care must be taken that both points are made to correspond both in length and breadth. Some pens are made with a joint to unite the two blades together, as shewn applied to the compasses, Figs. 3 and 8, and these have a small spring between them, to force them open. The screw for adjustment is the same as the former. The pen of the pocket compasses, Fig. 7, is adjusted by means of a sliding ring \( f \) fitted over the two halves of it, because there is in this case no room for a screw, when the pen is inserted into the hollow of the leg of the compasses. By sliding the ring down towards the point, the pen is closed up; or, by sliding it upwards, the points are suffered to open. The same mode of adjustment may be used for a drawing pen.

Fig. 23. is one of Mr. Donkin’s patent steel pens, which is intended for writing; but as it is a useful instrument for drawing, we introduce it here. The other kind of steel pen is as perfect as can be wished, for drawing straight or regularly curved lines, where some guide is used for it; but it will not do for those lines which are to be drawn by the hand, unassisted by a ruler, or other means of directing the pen. It is the usual practice to draw such lines with a crow, or goose quill pen; but they can be much more neatly executed by Mr. Donkin’s, which is the best writing steel pen that has appeared. The nip or point consists of two pieces of thin steel plate \( a, a \), put together nearly at right angles to each other; and the part where they meet is mitred, to make a joint for the slit of the pen, which is quite close, except when the pen is writing, and then the pressure bends the blades, and causes the joint to open sufficiently to deliver the ink; therefore, in proportion as this pressure is increased, the line becomes broader, in the same manner as the common goose quill pen, but with the advantage of being much more elastic in the blades of the nip, because they are filed very thin just above the point. The pen writes finer than a quill does, except the minute after being mended, because the points are made of a very hard substance; and when once made up carefully to write or draw fine, will not speedily wear out. The two pieces of steel \( a, a \), composing the nip, are united, by being soldered to a piece of metal, and this fits in the silver tube \( d \), which forms the handle. The shape of the point which writes is not easily described; but may be considered as similar to the point of a quill writing pen of the best form, except that the two pieces which form the nip are not portions of a cylindrical tube, but two flat plates situated at right angles to each other; and it is this circumstance which gives it the superiority over other steel writing pens, because the flat sides are very elastic, and bend freely; but a portion of a tube cannot spring readily, however elastic its substance may be.

The thin plane before mentioned, just above the nip, is reduced by filing from the inside, to allow the points to spring; and is of further use, to form a slight cavity where the ink rests, and is ready to pass down to the paper the instant the slit of the pen is opened, by pressing on the paper. The handle of the pen is made of three tubes, \( d, e, \) and \( f \), which shut one into the other, for portability; but when drawn out, as in the Figure, form a sufficient handle to write with.

The point of the pen, as shown separate at \( z \), draws out of the lower end of the external tube \( d \), and being inverted, and thrust in, is secure from injury; and thus the pen requires no other sheath when carried in the pocket. When a pen of this kind is used for drawing, its point must be very carefully made sharp, by rubbing it upon an oilstone, and it will draw better than any other for such lines, as the steel drawing pen will not execute.

Rules for accurate purposes should be made of steel, or brass; but as these are liable to contract, tarnish, or rust, and then soil the paper, wood and ivory are preferred for general purposes; still no artist should be without accurate brass or steel rulers of considerable length, to lay down his principal lines, and to verify his smaller rulers. A convenient standard brass ruler may be two feet and a half in length, and have inches and decimals accurately divided upon one edge of it, and decimals of a foot upon the other. One edge should be bevelled or made sharp to draw lines by, and the other left the full thickness of the ruler, but both should be very exactly straight. When rulers are made of wood, it should be of a hard texture, such as mahogany, box, beef wood, or ebony, and pieces should be carefully selected which have a clean straight grain, as these are the least liable to warp. The edges which are to be used to draw the pen against should be always bevelled, and very smooth. To verify the edge of a ruler, a very fine line should be drawn by it, taking great care to hold the pen perpendicular, and apply it fairly, then move the ruler to the opposite side of the line so drawn, and reversing it end for end, that the same edge of the ruler corresponds with the line, examine if it does exactly correspond in the whole length, which it cannot, unless both the edge and the line are very straight; because this mode of trial doubles the quantity of the error, and therefore renders the smallest deviation apparent. Ivory is the best substance for ivory, small rulers and divided scales, because being so smooth, the drawing pen slides freely against it, and draws beautiful lines: The divisions also, when filled with black, are more apparent to the eye than on any other substance. The only objection to it is, the liability to warp on every change of weather; but if carefully selected, some pieces may be found to preserve a very straight edge under all circumstances. The shape of the tooth among those, which are cut from the centre of the tooth, having the grain of the ivory radiating each way from the centre of the ruler to the edges, to appear something like the feather of a quill; in this case, both edges being of similar texture, they expand or contract equally, by the moisture or dryness of the atmosphere, and therefore do not change their figure. Scales of this kind, and about 12 inches in length, are extremely useful when divided, as shewn in Fig. 15. These are called plain or plotting scales, and are divided into 10 and 20, 30 and 40, or 50 and 60 per inch, as the artist requires. They are much more accurate for drawing than a scale made on the paper, and more convenient, because the divisions coming to the edges of the scale,
distances can be marked off upon the paper without the compasses.

For the use of surveyors, Mr. Farcy has contrived a small offset scale, Fig. 16, which transfers the division of the long scale to the paper very readily. The offset is made exactly twice as long as it is broad, and has a line drawn across it in the middle, which, when used, gives it into two squares from which one side is zero. It is graduated with divisions of the same value as the long scale, which it is to be used with. These divisions are numbered both ways. From the centre, the ends of the offset are exactly perpendicular to the sides; and when it is applied, as in the Figure, to the edge of the scale, which is held fast down upon the paper, while the offset slides along against its edge, any number of short lines may be drawn by the edge of the offset, and will always be parallel to each other, because they are all perpendicular to the line of the ruler. The divisions of the long scale show their distance from each other. For lines which do not exceed three inches in length, this is more convenient than any other kind of parallel ruler; but its principal object is to project points on irregularly curved lines, such as $a \times y$, to represent brooks, fences, &c. in maps. Suppose the right line $a b$ to represent one of the straight lines of the survey which has been measured upon the ground, beginning at $a$, where the curved line intersects it, and proceeding to $z$, 50 feet, yards, or links of the measuring chain, the perpendicular, or offset, from the line to the hedge was found to be 16 of the same denomination at $z$, which is 65 from $a$, the perpendicular offset to the curve line is 28; and thus by a number of offsets, the whole curve is determined. The usual method of plotting this is, lay the scale, Fig. 15, to coincide with line $a, b$, and mark off every division where an offset was taken; then at these points draw perpendicular lines, and upon them mark off the length of the several offsets. By the offset scale, Fig. 16, all this is effected at once. Thus hold down the long scale as in the Figure, so that when the offsets slide against it, its centre line will always pass over $a, b$; also when the edge of the offset is at the commencement $a$, it must likewise be at zero of the long scale. Now slide the offset till its edge comes to the division 50, which is the first offset, and here mark off the division 16 upon the offset for the point $x$; then slide it to 65 on the long scale, and mark off 28 for the point $z$; and so on for $y$ and any number till the curve is completed. This offset scale will likewise be useful to the mathematician in setting out any curve, which is expressed by the ordinate and abscissa, by calculating from the equation of the required curve. Let him make a table, showing the relative lengths of several ordinates to their corresponding abscissae, and he then proceeds to project the points as before described. To the naval architect it is very serviceable for projecting the different sections of a ship, when their lines have been determined in numbers by calculation.

Parallel rulers are of various constructions. The simplest and most common consists of two light rulers $A B$, Fig. 12, united together by brass links $a, b$, of equal length; and the two points on each ruler, where these are jointed to them, being also of the same distance, forms a parallelogram, the joints of which moving freely, the two rulers may be separated, but will always be parallel. In practice, the edge of the ruler $A$ being placed to coincide with any line, the ruler $B$ is held fast down upon the paper; and the ruler $A$, when opened out to any distance from the other, will always

Mr. Eckhardt's parallel ruler.

The wheels are slightly indented upon their circumferences, that they may not slip upon the paper; and being made exactly of the same diameters, they carry the two ends of the ruler forwards an equal quantity, and therefore the edge moves parallel. The distance which the ruler moves is also measured at the same time, by means of two small ivory wheels $e, e$, which have divisions upon them, so proportioned to the size of the ruler, that each division is equal to one-tenth of an inch of the ruler's motion, and these may be subdivided by sight. The divisions are read against an index, fixed upon the ruler at $d$, and the same piece forms a centre for the pivots of the axis of the wheels.
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Drawing

Instruments.

This invention is better in theory than practice; the rollers being liable to be diverted in their motion by the least irregularity on the paper, and it therefore requires to be used with the greatest care, otherwise it will not be so accurate as the common instruments.

Of all methods of drawing parallel lines, the drawing board and T square is undoubtedly the best. This, as commonly used, is too well known to require any description; but in Fig. 19, a square and drawing board is shewn, having some improvements. The edges have slips of box, or other hard light-coloured wood, inlaid; and these being divided into those scales which are most frequently required, will be found extremely convenient to work from, without requiring compasses. The divisions on the adjacent sides of the board are of the same scale; but those upon the sides which are opposite to each other are of different values. This renders the use of the board more extensive, because it is the two adjacent sides only which are used for the same drawing; one being used for the measurements of lengths upon it, and the other for heights of elevation. The drawing board is represented to be fixed down at the angles by pins with a large flat head, such as is shewn in its full size at Fig. 4. The point is sharp, and is pressed down into the board. Another method of holding the paper, is shewn in half its full size in Fig. 18. a is a steel screw, passing through the board with a thin, flat, conical head, which is very exactly fitted into a brass cell b, fixed fast into the wood of the drawing board. The screw is tapped beneath, and has a nut c upon it, to draw it down. The Shank of the screw is made square, that it may not turn round in the cell b. The edge of the paper being introduced under one side of this conical head, and the nut c turned, it draws the head a down upon the paper, and pinches it tight into the cell, so as to hold it fast; and at the same time makes no elevation above the surfaces of the paper, which can obstruct the passage of the square or other rulers over it. The stock A of the square AB, Fig. 19, is as usual made of three times the thickness of the blade or ruler B; so that when either side is turned upwards, the stock presents an edge projecting beneath the plane of the blade B, which being applied to slide against the edge of the drawing board, keeps the ruler in all situations perpendicular to it. The upper of the three projecting edges, which is seen in Fig. 19, at A, is not formed of the same piece as the other part of the stock, but is a thin ruler fitted upon it by a centre-screw a, and has another screw b passing through a curved slit to fasten it. By revolving this screw, the inside edge of this ruler can be made to incline, at any required angle, with the edge of the stock on which it is fixed, and with which it is now represented as coincident. There is a semicircular part at b, which is divided into degrees, and reads against a vernier, divided upon the lower part of the stock; and by this angle is measured. The use of this moveable side to the stock is to draw lines inclined to others at any required angle, or indeed to answer all the purposes of a protractor. Thus having with the edge of the ruler B of the square, as it stands in the Figure, drawn any line, set the moveable part of the stock to the required angle, by the divisions at b; then turning the square the other side upwards, and applying it to the edge of the board, the ruler B will make the required angle with the former line, and also with the edge of the drawing board; and by applying the square to the adjacent side of the drawing, a line may be drawn at right angles to the inclined line.

This is called a square with a bevel, and is very useful for drawing long lines inclined to the sides of the board. But for short lines, the instrument, Fig. 17, is more useful. This is a small bevel or ruler, jointed like a sector, with two limbs moving on a tight joint; the edges are bevelled towards the inside, for ruling against. In use, it is laid against the edge of the square, as at M, Fig. 19, and may be opened to any angle; then by sliding it along the edge of the ruler B, or moving the ruler up or down across the width of the board, the edge of the bevel may be brought to draw in any part of the paper; and having drawn a line in one place, will draw another parallel to it at any distance. It will also draw lines anti-parallel, that is, reversed, or making the same angle in an opposite direction. This is done by reversing the bevel, as shewn by the dotted lines; and will be found extremely useful for drawing the opposite sides of the roofs of buildings, or any other inclined lines. The same bevel when applied against the edge of a ruler, as at Fig. 17, will divide a line into any Fig. 17. required number of equal parts. Thus, for instance, suppose the space between the points a and b is to be divided into seven equal parts. To do this by the bevel, lay the inside edge of one leg D, to cross the line at one of the points, viz. a; then place the edge of the long ruler 15, behind it, and hold it fast down, that the bevel may slide freely against its edge, but without deviation from its direction. Now open the bevel to such an extent, that when the division numbered 7. on the inside of its limb E, is brought, by sliding the bevel against the ruler, to intersect the line which is to be divided, the intersection shall be at the other extreme point of the space to be divided, viz. at b. The instrument is now prepared; and to mark the divisions, slide the bevel against the ruler, till the division No. 6. intersects the line. There draw a mark by the edge of the bevel, cutting the line a b, as at g; next bring the division 5. to cut the line, and mark No. 5; and so of all the rest, and the line will be divided into seven, as required. It is plain, that if it had been required to divide it into seven and one-third, instead of seven, the same process would have effected it, by only preparing the instrument, by opening the bevel so much more as to bring the division seven and one-third to cut the line at the point b, instead of seven. It is for these fractional numbers the instrument is chiefly useful, because it is so difficult to do them by the compasses.

Dividers, or measuring compasses, are shewn in Fig. 5. They have nothing particular in their construction, which is not apparent from inspection, except the addition of a clamp and adjusting screw, to adjust and preserve the opening of the compasses. This consists of a piece of steel A a, which is formed to a screw a at one end; and the other has a slit or opening made through it, for the reception of the milled-head screw d, which screws into the leg of the compasses, and thus with a clamp binds the steel A a fast against it. B is a milled-head nut, into which the screw a is received. This nut has a shoulder and a neck, or small part, which is fitted into the socket e, formed of a piece of brass fastened to the other leg of the compasses by a round pin, which is adapted to a hole through the leg, and secured by a nut, or screw, on the other side, from either drawing out or shaking; and the nut B is so fitted to its socket e, that it will not draw out, though it turns freely. The utility of this clamp is very great, for measuring accurately, or dividing lines or circles into a great number of parts. When the screw d is loose, the compass joint can be opened or shut on their common joint, as easily as any common pair; but clamping the screw d fixes them quite fast. Still they admit of a delicate
adjustment, by turning the nut B, which gives a slow progressive motion to the screw a, and thus to the points. This we consider as the best pair of dividers we have seen, for the clamp is very steady, and quite convenient to use when great accuracy is required; but for ordinary purpuses, it may be quickly removed altogether, by taking out the screw d, and the socket e. The dotted lines shew another sort of clamp, which is simply a curved piece of steel plate, with a slit through it, for the reception of the screw d, which is tapped into the leg of the compasses. The other end of the clamp is fastened to the opposite leg by a single screw. This makes a very effectual fastening, to prevent the distance to which the points of the compasses are opened, but is not so good as the preceding, because it wants the adjusting screw.

Fig. 1. is a small pair of dividers. These have no joint, but are cut out of one solid piece of steel, and always tend to open by their own elasticity. They are shut up and adjusted by the small screw a, which is tapped into one leg, and passes through a hole in the other. The upper part of the compasses forms a handle for them. The points b and c are made to screw into the legs, in order that they may be taken out to sharpen them upon a hone; and also because the points require to be made of cast steel, and left of a hard temper, whilst shear steel, and of a spring temper, is more fit for the upper part, as it requires elasticity and toughness. These form a most useful instrument for setting out a great number of small equal divisions, not being liable to alter whilst in use; and the screw gives the means of adjusting them very accurately. Spring compasses are often made on a larger scale, but are not then advantageous for drawing, because they take too much time to set them by the screw. There are likewise what are called hair compasses, because they measure to a hair's breadth. They are a pair of common dividers, but the steel part of one of the legs is attached to the brass by a long spring, which constantly tends to throw the point inwards, and is counteracted by a screw passing through the brass, and tapped into the leg, so that it draws the leg close to the brass. Having opened the compasses nearly to the distance required, by turning the screw, the point is accurately adjusted to it. The only objection to this is, that the leg, depending only upon the spring, is not strong as it should be, but yields very materially when pressed into the paper, and is not therefore to be depended upon for accuracy.

Triangular compasses, (see Fig. 2,) are very useful in taking the distances of three points at once. A is the edge view of a pair of compasses, such as shewn in Fig. 5, and B a third leg, attached to them behind by a joint a, which is formed out of the pin b passing through the centre of the principal joint. These are chiefly of use to surveyors in transferring triangles: at one operation they measure one side between the point of the compasses A, and then adjust the point of the leg B to the third angle of the triangle. By bending the joint a, it will advance to or recede from both legs together; or by turning it sidewise on the centre pin b, it may be brought nearer to either of the other points at pleasure; and thus the joint a having the properties of an universal joint, the compasses will take in any triangle.

Proportional compasses, Fig. 6. These have points at each end, the centre or joint being in the middle. They are for reducing drawings in any required proportion. Thus, any distance being measured between the points A, B, by inverting the compasses, and employing the points a, b, they will measure out a distance equal to one half of the former; or the proportion may be varied at pleasure, by altering the position of the centre D. For this purpose, the limbs or legs have slits made through them, which are cut dovetailed, and have pieces of brass fitted into them; and these two pieces are united together by a steel pin, which forms the joint. It is fitted through one piece with a round shank and a conical head, and into the other with a square; beyond this it is formed to a screw, and has a nut D fitted upon it, for the purpose of binding it tight, and thus fixing the sliding pieces fast in any part of the grooves where they are set. When this nut is loose, and the compasses shut up, the slides can be moved in their grooves, by applying the finger and thumb, to set the centre in a situation for any required proportion; and for this purpose divisions are made upon the instrument, to set the slides by; and these are numbered to show the value they bear. Thus, on one edge of the front side of the instrument are divisions, entitled lines, numbered from 1 to 10; a line which is marked across the slider being brought to coincide with any of these divisions, will divide the length between the points A a and B b in such proportion, that the distance included between the points a, b will divide the distance included between the great points A, B into as many parts as the number shows. The compasses will therefore reduce any drawing in that proportion, by measuring the distances on the original by the great points, and marking them on the reduced copy by the points at the opposite end. It is evident from the Figure, that the two legs of the instrument are not in the same plane; but one lying over the other, they appear as one when they are shut up; and there is a small stud f fixed on one, which enters a notch made in the other, and this keeps the two limbs together, whilst the centre is moved, which cannot be done except when the two legs are shut up, because it is there alone that the grooves are parallel. On the opposite edge to that containing the divisions of lines is a line of divisions, entitled circles. These are numbered 1 to 20; and the index being set to any number, the points will open in the proportion of the radius of a circle to the side of an inscribed polygon of that number of sides. Thus, if it is set to No. 8, and the points A, B are opened to the radius of any circle, the opening of the opposite points will divide the circumference into eight equal parts. On the back face of the compasses are two other lines of divisions, one entitled planes, and the other solids; these are in fact lines of square and cube roots, and are rather useful in calculation than in drawing. The line of planes or squares, shows the proportion between the areas of similar plane figures. Thus, set the centre to No. 3, and measure the side of a square in the long points, the short ones will then mark out the side of a square, which will be one-third of the area of the other; the same of triangles, circles, or any other regular plane figures. The line of solids is in the same manner, to express the proportions between cubes or spheres. Thus, set the centre to No. 2, then measuring the diameter of any sphere, or the side of a cube, with the long points, the others will show the dimensions of a sphere or cube, which will have one-half the solid content of the other. The best kinds of proportional compasses are provided with an adjusting screw, clamp and screw, like that which is applied to the measuring compasses Fig. 5; and this is so adapted, that it may be either extended between the legs, to adjust the opening of the points, or it may be attached to the sliding centre to give it a delicate motion, for the purpose of
ADJUSTING it accurately to the divisions marked upon
the legs. This contrivance is very useful, when the
compasses are employed to make calculations by means
of a plain scale of equal parts, but it is not requisite for
the ordinary purposes of drawing.

Drawing compasses for describing circles, are of sev-
eral kinds; but, in general they have points, which
are changed to draw either in pencil or ink. Fig. 8,
is a pair of compasses, which are the invention of Mr
Brunel, and we think them better adapted for general
purposes than any others we have seen. The legs or
shanks consist of two tubes A, B, united by the joint at
C, the opening of which determines the distance be-
tween the points of the legs a e and b f. These legs are
not attached immediately to the tubes A, B; but, by
the intervention of joints c, d, the points can, in all situa-
tions, be set perpendicular to the paper, or nearly so,
without which the pen cannot draw a fine line, nor can
an accurate measure be taken between the points. Be-
nath the joints c, d are a second pair, formed by a steel
pin g, fixed into the legs, and fitted through the joint-
pieces c, d. These joints bend in a direction perpen-
dicular to the upper ones, and are for the purposes of
changing the drawing points by inverting the legs, each
of which has at one end a plain steel point, marked b
and e for measuring, or for a centre point; and at the
opposite ends, one has a port crayon f, and the other
is furnished with a steel pen a. This forms a complete
pair of measuring and drawing compasses, without any
loose parts, which are liable to be mislaid, and occasion
inconvenience to change them; for in these the parts
are changed instantly. Thus, in the Figure, they are
in a state to draw circles with the pen a; but, by turn-
ing the bag end round, on the joint pin g, the plain
measuring point e is brought into use for taking dis-
tances; or by bending the joints c, d, so that the points
are directed towards each other, they become well
adapted for calibrating any circular bodies. For draw-
ing circles in pencil, the leg b f must be inverted. The
joints g, are screwed up tight, so that they move ra-
ther stiffly, and are not therefore liable to alter by the
action of drawing, though they are readily turned to
change the points. The tubes A, B are double, that is, eah
contains another smaller tube fitted within it; and
the joint-pieces c, d, being attached to the internal tubes,
whilst the parts of the principal joint e are fixed to the
external tubes, the compasses can be greatly enlarged
by drawing out the tubes in the manner of telescopes.
They must of course be very accurately fitted into each
other, and have sufficient friction to preserve the situa-
tion to which they are drawn out. When drawn out to
the full extent, these compasses will describe a circle two
feet four inches diameter, or twenty inches in diameter
without extending the tubes, although the real size of
the instrument is very little more than double that of
the Figure. This great power is obtained by the legs
having joints to set them perpendicular; and the tubes
may therefore be brought into a straight line with each
other, and the compasses act as well as before. The
frames are, besides light, and nearly as strong as solid
ones; on the whole, we can recommend them as the best
instrument we have seen for general purposes, at least
for large circles.

The bow compasses must be used for smaller sized
circles than the others will conveniently draw. A very
capital pair of these is shown in Fig. 3, of nearly their
real size. They have solid shanks and joints at c, d to
place the points perpendicular. The points themselves
are moveable, being fitted into sockets, and held fast by
the screws g, g. This admits of changing either of them.
The plain point for measuring is shown at R, and the
port crayon, or pencil leg at S, and also a dotting wheel
leg at Z, Fig. 9. Its structure has been before describ-
ed. Bow pens are always provided with a handle D
at the top, which is fixed upon the joint, and is very
useful to turn the compasses round as delicately as they
require to be moved for drawing very minute circles.
A duplicate pen-leg is frequently provided for this in-
strument; and both pens being fixed at once, it will
draw double lines at any required distance asunder, a
property which is very useful to surveyors for drawing
roads in maps. By fixing the dotting leg and the pen
leg at once, the roads may be drawn with a dotted line
at one side. Some artists prefer having two sepa-
rate pair of bow compasses; one for a pen, and another
for the pencil; they do not therefore require the socket
joints g, g, which, for very nice purposes, are rather ob-
jectionable; for unless the sockets are extremely well
fitted, the points will not meet sufficiently near to draw
the smallest circles; still a pair of these, when in good
order, may be made to describe circles of only one
thirtieth of an inch in diameter.

Pocket compasses of the best kind are shown in Fig.
7. The shanks AB are made hollow for the reception
of the upper part of the legs, which separate at the
joints e, f. The legs have joints c, d to set them perpen-
dicular. One of the legs is shown detached to explain
its mode of operation. It will be seen that the plain
point at one end, and the port crayon at the other. It
has two parts at l and m, each formed to fit into the
sockets or end of the tube forming the shank of the compasses. This admits of either point being brought into use or the other end of the leg may
be introduced into the hollow of the shank, and then
the opposite leg may be in use. The parts l, m must
be accurately fitted into the sockets, and must be at
equal distances from the points, otherwise the points
will not be of corresponding length when changed. The
leg q with the steel pen has likewise a plain point at the
other end, which is concealed within the hollow of the
shank A. The fitting of the parts l and m consist of a
round pin accurately fitted into the sockets at the ends
of the tubes, and with a small steel feather or fillet fix-
ed, projecting from one side of the pin, and received into
a corresponding notch in the side of the tube. The
great convenience of these compasses is their portabil-
ity, for the points or legs being put into a sheath or
thimble, they can be carried in the pocket without
any other case, and contain a very good set of instru-
ments in themselves, which an artist may at all times
carry about with him. The only objection to them is,
that if they are much used, the sockets wear, and the
legs will then have a shake or looseness, which must of
course be destructive of all accuracy, in either drawing
circles or measuring distances; neither can the points
be changed so readily as those of Mr Brunel’s, Fig. 8,
which are merely inverted.

We have now described all the jointed compasses
which we think particularly worthy of notice; for
through a number of different constructions beside those
are in constant use among artists, they are not so per-
fected as the above. Compasses require exceeding good
workmanship, particularly in the joints. The parts of
these should be always composed of two different met-
als, and are best made by soldering or brazing two
thin plates of steel to one leg, and fitting them into cor-
responding openings or clefts cut in the metal com-
posing the other leg, which is generally brass or silver.
The centre pin should be steel, and accurately fitted

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Mr Brunel’s compasses.

Plate CXXXVII.

Fig. 8.

Pocket compasses.

Fig. 7.
to the holes made through all the parts of the joint. At one end it has a head of brass or silver riveted fast upon it, and on the other end a similar head is screwed, which is therefore a nut, and being turned by a screw driver, binds the joint tight to produce any degree of friction or stiffness required; for the object in making a joint is to give it a great degree of friction, and at the same time to be perfectly equable and regular in all parts. For this reason the joints should always be double, that is, have two pieces of steel in the joints, by which means there are four separate surfaces in contact to produce friction, and are therefore less liable to wear than if there were only two surfaces, which is the case when only one piece of steel is used. The joints of all compass instruments not being so well fitted in the circular part have leaves or projecting parts on these steel pieces, which enter notches at the upper part of the opposite leg when the compasses are shut, but these leaves draw out from the notches as the compasses are opened. This is not a good method, because the friction is then unequal at the different degrees of opening, and such compasses are liable to jump suddenly when shut up or opened by the gradual pressure of the fingers. All the instruments in Plate CXXXVII. are made fit in the circular part of the joint only, and this should be made large enough to give as much steadiness as the instruments require. The steel legs of compasses should be of cast steel, hardened and well tempered at the points, so that they will preserve a sharp point, without being so soft as to turn up even when used on brass or copper, or so hard as to be brittle. The upper part of the steel above the points should be of a spring temper, and then they cannot become bent by any accident, so as to prevent the points meeting each other precisely as they should do to measure minute distances.

When the points by gradual wear become dull, they should be repaired by sharpening on an oil stone or hone. The insides of the points should first be rubbed quite flat upon it, till on shutting them together the two points meet as if they were one; they are then to be rubbed on the different sides till both are brought to fine points, which should be tried on paper, till they make very delicate punctures. The strength of the legs should be such, that when the pressure of the fingers is applied to the compasses to open or close them, they will not bend or spring sensibly by the force which is requisite to open or close the joint; if this is found to be the case, the joint must be relaxed by turning the nut of the screw. No accurate measure can be taken in compasses which are so tight in the joint as to cause the legs to spring in opening or shutting, because when the points are brought by the pressure of the fingers to the required opening, they alter their distance the instant the pressure of the fingers is relieved as much as they spring, which, in some compasses, is a very considerable quantity.

For measuring very long distances, the beam compasses alone can be used, and also for drawing portions of large circles. They are usually made with a wooden beam, as shewn in Fig. 13, and two brass sliders A, B fitted upon it. These have screws through the upper part of them, by which they can be fixed fast upon any part of the bar; and in the lower part are sockets for the reception of the different points c, b. These consist of two plain steel points, a steel pen, and a port crayon. A screw d is mounted in a socket or frame, screwed to the end of the slider B, and this screw is tapped into a piece of brass which is fixed at the end of the wooden beam; therefore by turning the screw round by its head d, it acts upon the slider B, and slowly ad-

vances it upon the beam to the exact distance required. In the best instruments, the head of the screw has a circle fixed upon it which is divided, and thus the quantity that the point is moved by the screw is ascertained with great precision. The same compasses have generally several beams of different lengths, as it is inconvenient to have a beam of much greater length than the distance between the points.

When arches of circles of very great radius are to be drawn, the beam compasses are not the best instrument; even when they are extended to five feet in length, the beams are very liable to bend by their own weight, and thus throw the points farther from each other. They must be used to handle them delicately and support the beam in the middle.

Many artists require very large circles, particularly those who project maps of extensive countries. To these we can recommend the instrument Fig. 14. This consists of two rulers A, B, united by a joint at C, which admits of placing the two at any required angle with each other. They have each a circular part behind the centre, and in the upper one is cut a curved groove for the reception of a screw d, which screws into the lower one; therefore by screwing this tight, the two are immovable fastened together at any angle at which they may be set. The centre pin of the joint C is perforated, forming a tube to admit a cylindrical pen, on the lower end of which the drawing point or pin is fixed, and in such a position that its point is in the intersection of the edges of the two rulers A, B. When this instrument is used, two weights E, F are laid upon the table, and they have sharp edges, against which the rulers are applied, as in the Figure; and when it is slid along against them, the centre point C will describe an arch of a circle. The edges of the weights E, F are only necessary to represent a stationary support against which the rulers can be applied; and therefore two pins or needles stuck in the table would have the same effect, and indeed are often used. For the same purpose, each of the weights must have three small pins in the underside of it, which are pressed into the table to hold it fast. By altering the angle of the two rulers, the instrument will draw a segment of a circle of any required radius; and the mode of setting it is extremely simple: First, mark on the paper two points, which are to be the extreme limits of the arch to be drawn; then, by drawing the chord and versed sine, an intermediate point upon the curve between these two may be found; now fix two pins in at the extreme points, or place the weights E, F so that their edges match these points, and apply the instrument to them; now loosen the screw d, and open or close the angle of the rulers A, B, till the centre point C exactly falls upon the intermediate point in the curve. Here fasten them by the screw, and the instrument is ready to draw the curve by sliding it gradually against the pins, whilst the pen in the centre traces upon the paper.

Fig. 21 is an instrument for dividing circles into Farey's divisions, which was invented by Mr Farey. It consists of a light brass or silver circle AA, having a cross bar a with a centre screw fixed in it; and the point of this screw is made very delicate, that it may enter the paper without making an unseemly puncture. Upon this centre the circle revolves, and its circumference has several circles upon it, which are divided in an engine, and holes drilled through the plate at every division, in the same manner as the divided plates of the engines used by watch-makers for cutting cog-
wheels. There are 6, 7, 8, or 9 of these circles, each containing a different number of holes or divisions; thus the outer one may be 360, then 100, 96, 90, 84, 72, or it may have any other numbers at pleasure, though these will be found sufficient for general purposes. These divisions are transferred to the paper at any radius, by means of an index c d. This is a piece of steel attached to an axis e f by means of a thumb screw g, which passes through a slit in the index, and screws into the axis beneath, so as to bind the index fast, and attach it firmly to the axis e f; but when the screw is loose, the index will slide, so as to bring the screw c nearer or farther from the centre, to adjust it to the radius of the circle it is intended to divide; for it is the point of this screw which pricks into the paper to mark the divisions, and it is for this reason made very sharp. The axis c f is supported upon the points of two centre screws, fixed through holes projecting from the central bar a; and there is a small spiral spring, consisting of a slender piece of music wire twisted round the axis, being secured to it at one end by passing through a hole in the axis, and the other end is turned up to rest on the central bar a; by this means it constantly tends to throw the prick ing point of the index upwards from the paper. The divisions of the circle A are united by a steel point, at the end of a small detent l m, which moves on a centre, and has a spring under it at the end m, to throw the opposite end down, and cause its point to enter the holes as they pass in succession beneath it, when the circle turns round. The centre of the detent is supported in a piece of metal n, which has three very small points in the under side of it, that it may fix itself firmly upon the paper, when held down by the pressure of one finger placed upon it. The manner of using the instrument is this: Place its centre point in the prick which has been previously made in the paper, as the centre of the circle intended to be divided, and which may, if thought proper, be drawn in pencil; then loosen the screw g, and slide out the index till its point c reaches the circle, and here fasten it to the axis by the thumb screw; now take the detent, and choosing the circle containing the number intended to be divided, put its point into one of the divisions of that circle, and placing the piece n at any convenient part of the circle, press its three points into the paper to keep it steady, and hold it down by placing the second finger of the left hand upon it: The thumb of the same hand is to be placed on the rim of the circle, near the point A, for the purpose of moving the circle round upon its centre, and the fore finger is reserved to press down the tail m of the detent, and thus raise its point out of the divisions. Having with the thumb moved the circle round, till, by the point of the detent dropping into one of the divisions, it becomes fast, and will turn no farther, you press with the fore finger of the right hand upon the head of the screw c, and cause its point to prick into the paper, making the first division; then suffer the spiral spring to lift up the index c, and take its point out of the paper, and at the same time press down the tail m of the detent to relieve the circle from its points, and, with the thumb, move the circle till the point of the detent falling into another hole stops it at the second division; here prick the pin c into the paper, then lift the detent, and move the circle another division; mark again, and so on, till the whole numbers are divided, which may be done very quickly, and with as great accuracy as it is possible to obtain upon paper. The stud which supports the centre of the detent, turns round in a socket in the piece n, by which means it can be turned to reach any one of the circles of divisions at pleasure. If a circle is to be divided into one-half, one-third, or one-fourth, of any of the numbers divided on the Plate, it can be done by suffering the circle to move 1, 2, 3, or 4, divisions every time, before the prick is made, instead of once. The numbers divided on the circle may be doubled thus: Having divided one circle as described, subdivide one of the divisions; then loosen the screw g, and move the index sidewise the quantity of half a division, till on trial the point will exactly enter the subdivision at the time when the point of the index is holding the circle by one of its divisions; now fasten the screw, and proceed to divide the circle over again; then the division made the second time will fall exactly between those first made, and thus fill up the circle with double the number first set out. Instruments on this plan may be made to any size less than eight inches diameter.

Fig. 20. represents another instrument by Mr. Farey, which has the power of drawing lines, as well as marking points. The circle of this is exactly the same as the former, except that the radial bar has an arm behind it. The instrument is provided with a similar detent to count the divisions, but instead of the index for pricking, a brass frame a b c is fixed upon it by a screw a. It supports the ends of a steel wire a b, upon which is fitted a sliding socket d, adapted for receiving the leg of a pair of compasses l, which are of the same structure as Fig. 3: the leg fits fast in the socket, which may therefore be considered as one piece with the leg. The opposite leg of the compasses then stands in a proper direction to draw lines on the paper, when motion is given to it, by sliding the socket upon the wire. This must be very accurately fitted, to be without any shake, and it will then draw a straight line parallel to the wire. The length of this is limited to what is required by adjustable stops, 1 and 2, which fit upon the wire, and by means of a small screw can be fastened at any part: one of these stop the motion of the socket each way. It is plain that, by opening the compasses out, the lines may be drawn at any required distance from the centre; or, by twisting them round on the joints, which fix in the legs, they may be drawn at any part of the area of the circle, and their length is determined by the stops.

Fig. 22. is a very convenient protractor, combined with a dividing instrument, which was invented by Alexander Jaffray, Esq. It is a semicircle AA graduated on the circumference with degrees; and within this are several portions of circles divided into different numbers, and drilled through the plate like the former; the centre screw has a point to enter the paper, and it is also the centre for an index or limb CD. This has a vernier at the extremity C to apply to the graduated arch AA, and within it carries a detent which moves on two centre screws as an axis, and has a point to enter the divisions of the several circles. This point is fitted through a groove made in the detent, but can be fastened at any part of the length of the groove by a thumb screw, and in this manner it is set to any of the different rows of divisions. The tail of the detent is brought very near to the centre, to be convenient for the application of the finger upon it. The drawing of the lines, or marks, is performed by means of a ruler B, which is attached to the opposite end of the limb, and traverses over the paper, having a thin edge which points to the centre, as does likewise the edge e of the semicircle, when it is used as a protractor, the angle
made between these two edges B and e is measured by the divided arch and vernier; but when it is used for dividing, the point of the detent is set to the required circle, and the semicircle held down fast upon the paper, whilst a mark is made by the edge of the ruler, as shewn in the Figure. The tail of the detent is then pressed to relieve the limb from the circle, and it is moved another division, and here another mark is made by the rules, and so on, till as many divisions as the semicircle contains are made. Having arrived at the last, the ruler B is to be held fast, by pressing it down upon the paper, and at the same time holding down the tail of the detent. To release the circle from it, the semicircle may be turned round on the centre till the detent come to the commencement, and from this set out again to complete the dividing of the circle, holding the semicircle fast, and turning the ruler round a division at a time, as before described.

This instrument is scarcely so convenient to use as the former, on account of the interruption in the middle of the work to change the position of the semicircle; but it has one great advantage over them, viz., that it can be extended to circles of larger radius than the instrument itself, because the ruler B may be extended to any length required, whereas the others cannot divide circles larger than the area of the opening within them.

The pentagraph is an extremely useful instrument to copy drawings, which it will do either on a reduced or enlarged scale, or on the same size, at pleasure. For copying maps or drawings, where almost all the lines are irregularly curved, it is the most valuable, because there is no other direct method of obtaining copies of such lines. The principle of this instrument may be easily explained by Fig. 7. AB and BC are two thin brass rulers, united by a joint at B. DF and EF two shorter rulers, united at F, and attached to the long bars, by joints D and E. The proportions of the rulers are not important, except that they must form a parallelogram, DF being = BE, and DB = FE; therefore in all positions EF will be parallel to AB. The instrument opens and shuts freely upon its axes, and one of these is a small castor, or wheel, to support the weight of the instrument, as it traverses horizontally upon the table. A, G, and C, are three points upon the rules, where tubes are fixed to receive the drawing points. These three must be in a right line, as shown by the dotted line, and so situated that the distance CG will divide the distance CA in the proportion in which it is required to copy or reduce the drawing at A, upon the paper at G, by means of a pencil or point crayon, inserted into the tube G; at A, a blunt tracing point is fitted into the tube; and the third point is kept stationary, by means of a circular leaden weight placed upon the table, and provided with small pins in the underside, to prevent it from moving. The point C, therefore, becomes the fulcrum or centre on which the whole instrument moves; and with this motion, combined with that produced by extending and contracting the instrument, the tracer A may be passed along all the lines of the drawing, however irregular, and will communicate such a motion to the pencil at G, as to copy it exactly in the proportion of the distances CG to CA.

It has been before mentioned, that the three points must be situated in a right line; and it follows from the arrangement of the rulers, that they will, in all the motions of the instrument, continue in a line with each other, and will divide its length in the same proportion in which they were first set upon the rulers.

The instrument acts to copy and reduce on the principle of the lever; considering the imaginary line AGC as an inflexible lever, the fulcrum may be placed in either of the points G or C, and in the other the pencil is to be put.

The point A is always used for the tracer, which is applied to the original map or drawing, and the proportion in which the instrument will reduce is thus: As the distance between the tracer and the fulcrum is to the distance between the pencil and the fulcrum, so will the size of the drawing traced over be to the size of the copy made by the pencil. Example. Put the sliders G and C at such parts of their respective rulers as will cause the distance CG (when they are in a straight line) to be only half as much as AC; then if the fulcrum is placed at G, the pencil at C, and the tracer at A, it will reduce to one-third, because AG is three times as great as CG. On the other hand, put the fulcrum at G, and the pencil at C, and it will reduce only one half; because in this instance AG, from the tracer to the fulcrum, is twice as much as GC, from the pencil to the fulcrum. It must be remembered, that when the fulcrum is placed between the tracer and the pencil, the copy will be inverted with respect to the original; but in the former case, they will be parallel to each other upon the table, as shewn in the Figure. The pencil and tracer should be lightly oiled before they are used, to make them move freely in their tubes.

The tubes are fitted upon the rulers by means of sliders, (see Fig. 8,) which have a screw a, to fasten them at any point. The tube b has the port crayon d accurately fitted into it; and this has a cup or box on the top, by which it is loaded with shot or other small weights, till a sufficient pressure is obtained to make it draw a clear line. That part of the tube b which is beneath the ruler, is made of a proper size, to fit into a socket, which is formed in the lead weight, Fig. 9, at d, and it is this which forms the centre or fulcrum. The socket is very near the edge of the weight, that it may be so placed as to admit the motion of the castor, which is under the joint E, Fig. 7, when the socket is brought up near to that joint, for reducing very small. The accurate fitting of the points is very material for copying correctly; and the instrument must be used upon a very flat table, or the points will, by the friction of the instrument, be thrown out of the perpendicular. To avoid this danger as much as possible, all the joints are made with short axes, as shewn in Fig. 10, where f is the end of one of the rulers, having a short steel axis screwed to it. The pivot at the lower end of this is received into a tube g, which is fixed to the other ruler; and the upper pivot is sustained by a cock or bridge k, screwed to the same ruler. The tube g also receives the spindle h of the castor, or wheel, on which the instrument travels. This has at the lower end a piece of brass, into which the wheel is fitted, so as to turn upon its own centre; and by the spindle h turning within its socket, the plane of the wheel always accommodates itself to the direction of the instrument's motion. The spindle h is retained in its place by the point of a small screw entering a notch made round in the spindle. The rulers of the pentagraph are marked at C and G, with divisions by which the sliders are set; and these are figured, to shew the proportions in which the instrument will reduce when they are so placed.

Fig. 6 is an instrument, invented by Mr. Farey, for the purpose of drawing lines converging to an inaccessible centre. This is extremely useful to those who draw buildings, &c. in perspective, when the points to
which the lines should converge will often fall at a distance of 12 and 15 feet from the picture, so as to render it impracticable to use rulers; and there is, except this instrument and another recently invented, no other method. It consists of three rulers A, B, and D, which are united by a common centre screw; and have a thumb-screw d, which fixes them fast at any angle where they may be placed. E, F are two fixed weights, against the edges of which the rulers AB are applied, when the instrument is used; or pins may be fixed in the table, to answer the same end. By sliding the instrument against these stationary points, as shewn in the Figure, the ruler D will draw lines as shewn dotted, which are all convergent to a common centre, the distance of which will depend upon the angle of the rulers A, B, and the situation of the points E, F. The edge of the ruler D must in all cases be made to bisect the angle of the other two. The manner of setting the instrument is this: Having given the two extreme lines r, s (dotted), which converge to the intended point, we suppose it is required to draw a number of others to the same point. The pins or weights E, F must be set upon these lines, but situated equally distant from the centre point. To find their situation, place a pair of compasses with one point between the two lines r, s, so situated, that when a circle is described by the other point, the two lines will be tangents to it. From this point, as n, with a greater opening of the compasses, mark off two points, as at E, F, upon the lines, and these will be equidistant from the centre; and here place the weights, or fix the pins. Now apply the instrument to them, with the clamp screw d loose, and slide the rulers against the pins, till the ruler D comes to one of the lines r or s; and here place the rulers on their centre joints, till the edge of D exactly corresponds with the line, when the other rulers are kept in contact with the fixed points. Now remove the instrument to the other of the two lines, and adjust it in the same manner that the edge of D may correspond with it. The clamp screw being fastened, fixes the rulers as they are adjusted; and then, on sliding the two A, B, against the pins, the edge of the third, D, will in all positions tend to the same centre point as r, s, &c. The angle C, in which the rulers A, B meet, will in this motion describe a segment of a circle, as shewn by the dotted lines; and the centre to which the lines tend will be found in the opposite circumference of that circle, by bisecting the distance EF upon the dotted arch, and from this point drawing a line through the centre of the circle till it cuts the opposite circumference, and to this point the lines will converge.

If the instrument is required to have a greater range than between r and s, other pins must be fixed for it to act against, taking care that they are at the same distance from E or F as these are from each other. Their proper situation will be determined by the rulers A, B themselves, thus sliding the rulers against the pins till the angle C comes to one of the points E or F. The new point must be fixed in contact with the edge of the ruler, which is unsupported, and at the same distance as is between E and F.

The construction of the instrument will be apparent from an inspection of the Figures. The two rulers A, B have circular parts behind the centre, which apply one upon the other; and a projecting part b from the ruler D lies over both, the centre passing through all three. An arched groove is cut through both the circular parts, to admit the screw d, which also passes through b, and fastens them all three together, by screwing into a nut, which is fitted into the arched groove of the lower one. The ruler D is made of wood or ivory, as shewn separately in Fig. 6, and screwed to the under side of b, so that it comes into the same plane with AB. The instrument will draw parallel lines when AB are set in a straight line; and if the circular part is graduated, it will make a good protractor.

Fig. 6 is an extra ruler, to be applied in lieu of D. When the instrument is required to draw lines to a centre on the opposite side, it is merely reversed to the other, having the hole in L, which is for the centre, in the line of the opposite edge, towards the left hand side, and the other towards the right hand. This instrument has been lately rewarded by the Society of Arts, who have also rewarded Mr. Peter Nicholson, for the invention of an instrument for the same purpose, which he calls a centralised. It is on a new and very ingenious principle. See the Transactions of the Society of Arts, vol. xxxii.

Ellipses are curves so frequently required by all artists who draw in perspective, that instruments for drawing them to any size or proportion, are almost indispensable to produce correct representations of circular objects. The trammel, or elliptic compasses, Figs. 1 and 11, is the only method which is in general use. It consists of a brass cross, AA, BB, having two dovetailed grooves crossing each other at right angles. In these grooves, sliders are fitted to move freely, and without looseness. The sliders are perforated with holes for the admission of small pins, which project downwards from the sockets CD of a small brass compass, at the extremity of which a tube E is fixed, and in this a drawing pen is received. The cross is supported upon points, which act as legs, and at the same time point out the direction of the two diameters of the ellipses, which the pen will trace when the beam is turned round. In doing this, the sliders being united together by the beam, compel each other to advance and retreat in their respective grooves; and thus, by a constant alteration of the centre, produces an ellipse, instead of the circle, which would be drawn if the centre was immovable.

The rule for setting the trammel is to make ED equal to half the conjugate diameter of the intended ellipse, and EC equal to half the transverse diameter; therefore the distance DC will be equal to the difference of the two semi-diameters. Fig. 11, will explain this more clearly. This instrument is very defective, because it will not draw narrow ellipses, nor small ones, without interruption to the curve, by the arms of the cross, as shewn in Fig. 11. For very small ones, it cannot be used at all; neither will it draw ellipses which approach very near to circles, because the sliders cannot be brought sufficiently near together. Another inconvenience is, that when the cross is once placed, it must remain, and cannot be adjusted till it come to the exact position required upon the paper. For these reasons the instrument is not applicable to perspective drawings, as the greater portion of these ellipses which occur could not be drawn by it.

Fig. 2 is an ellipsoidograph invented by Mr. Farey, which is so general in all its applications, as to draw any ellipses whatever within the size of the instrument, and is readily adjusted. It consists of two circles A, B...
united together with screws, with any required degree of eccentricity from each other. These revolve between four rulers, DE and FG, firmly screwed together to form a frame: but they are in two different planes, as shown by Fig. 3; so that the upper circle is included between FG, and the lower between DE. Both circles are accurately fitted, with liberty to slide freely between their respective rulers, but have no other motions; therefore the centres of the two circles always move in right lines, which are parallel to the rulers, and at right angles to each other, as shewn by the dotted lines ED and FG. The curve is traced by the pen of a pair of compasses MH, situated as shewn in Fig. 5, the leg being stuck fast into a socket H, which moves on a centre or axis; and the pen M of the compasses is capable of being lifted up at pleasure, that it may not mark upon the paper: and when in use, this centre permits the pen to follow the surface of the paper, and always press upon it with a proper force to draw neatly. The circles of the instrument are turned round by means of six small handles f fixed in the circumference of the upper circle, and to any opposite two of these the finger and thumb of the right hand is applied, whilst the frame of the instrument is held firmly down upon the paper by the finger and thumb of the left hand pressing upon the two nuts O, N; then turning the circles round in their frame, the pen will draw the ellipsis as in the Figure. The principle on which this instrument operates, is the same as the trammel. To shew this, Fig. 11. represents the same ellipsis as in Fig. 2, with a trammel properly set for describing it in the manner before explained. The alteration consists in extending the diameters of the pins which act in the grooves, till they become the large circles, AB, Fig. 2; and then the rulers DE and FG represent the sides of the grooves in which the pins move. The point of the pin of the compasses M now represents the point E, Fig. 11. and draws the curve in the same manner; but by these alterations, the instrument becomes general in its application; for the point M has the power of extending any distance from the centre, and any required eccentricity can be given to the circles, still preserving the advantage that the point M can be actually brought to coincide with one of the points D or C, Fig. 11. when of course it will draw a straight line, and if brought to agree with both of them, it will describe only a point; therefore this instrument will describe all possible varieties of ellipses within the limits of its radius, either with respect to size or the proportion of its diameters. To explain the adjustment of the instrument, we must return to Fig. 2, which shews that the circles have no central bar, but instead of it have two bars a, a parallel to each other, and at some distance from the centre, leaving an open space between them, in which the drawing pen or tracing point is situated. There are also crooked arms b, b proceeding from the bars a, a to the circular rim, to give them sufficient strength; and these being all the bars across the circle, it leaves them sufficiently open to see the curve as it is traced beneath by the drawing pens. The circles are united by screws, which keep them together, but at the same time allow them to slide one upon the other, in the manner of the Figure, by means of a pinion K, the centre pin of which is fixed on one of the arms of the lower circle, and acts upon a rack d, screwed to the upper circle, so that it separates the two when turned round by its head K. But the circles are fitted together so tight by the screws, that they will not separate from each other, except by the power of the pinion, and may, in the motion of the instrument, be considered as firmly united together, though capable of having any degree of eccentricity given to them by means of the pinion K. The other adjustment, viz. that which removes the drawing point to any required distance from the centre, is produced by a pinion L on the opposite side, which gives motion to a small carriage or frame g. This carriage is fitted into the space between the bars a, a, and slides freely from one end of the opening to the other by means of a rack h screwed on one side of it to act in the teeth of the pinion L, which turns on a centre pin fixed in the upper circle BB.

The frame g has the brass socket H within it fixed on a centre pin extended across the frame. There is a hole in the socket for the reception of the leg of the drawing compasses H, which stand, as in Fig. 3, when in use, the pen tracing the curve upon the paper, by the weight of the compasses bearing upon it. The manner of fitting the frame g into the bars of the circle is shewn in Fig. 4; and also the socket H moving on its centre pin, the rack d and the pinion K, which are for the purpose of separating the circles, and the other rack and pinion L, h for moving along the frame g between the bars. The frame g is so fitted that it continues at the same point with respect to the upper circle B, when the two circles are separated from each other by the motion of the pinion K. We have now shewn that the circles can be set with any required degree of eccentricity, and in this state are capable of revolving in the frame; and also that the tracing point or pen can be removed to any required distance from the centre of the upper circle B. We shall now proceed to point out the extreme cases of the instrument's action. Suppose the two circles set by the pinion K, exactly concentric with each other, and the pinion L turned till the end of the frame g comes in contact with the rim of the circle, then the point of the pen M will come exactly in the centre of both circles, which being turned round in the frame by their handles, the pen will only mark a small point on the paper, which will be the centre of any curve the instrument may be afterwards made to describe. By turning the pinion L, the point of the pen may be removed to any distance from the centre within the radius of the instrument, and it will when turned round describe a circle which may be made of any radius from the smallest point to the size of the circles. This is the simplest case of the instrument, and may be considered as an ellipsis when the difference of its diameters is infinitely small. When the circles are rendered eccentric, it draws an ellipsis, the breadth of which will be determined by turning the pinion L; and by the other K, the difference between its breadth and length is regulated. Suppose K turned, to render the circles concentric, without moving the other pinion, the pen therefore remains in the centre of the upper circle. In this case, the pen will describe a straight line, equal in length to twice the eccentricity of the circles. This is evident, because the circumference of the upper circle BB, moving between the straight edges F and G, its centre must describe a line parallel to them. This case may be considered as an ellipsis without breadth; for if the pen is set the smallest quantity out of the centre of the upper circle, it will describe a very narrow ellipsis, and by setting it at different distances from the centre, any required proportion of ellipses may be described.

When the instrument is held down to draw, it is kept steady by two sharp points, fixed in the ruler P, and penetrating the paper. This ruler is united to the frame by screws, on which the nuts N, O are screwed. The screws are fitted into grooves in the ruler P, in which
they slide; and they also pass through grooves in the ends of the bars of the frame. By this means, when the instrument is placed on the paper, it can be moved to adjust it to the exact position, where the ellipse is to be drawn, without disturbing the ruler P. To remove the transverse diameter of the ellipse, (the conjugate remaining the same,) the whole frame is moved by the screws sliding in the grooves of P; but to move it in an opposite direction, viz. to adjust the position of the ellipse endwise, the nuts must be loosened, and then the screws will slide in the grooves at the ends of the bars FG. When the nuts are screwed fast, this motion is prevented, though the screws will still slide in the grooves of P.

The properties of this instrument will be rendered most evident, by some examples of the manner of using it. All that is required, as data for describing any ellipse, or any number within or near each other, is, to sketch them in pencil on the paper, and mark, by the compasses, the four points upon each curve where its two diameters intersect it. Place the instrument upon the paper in such a position, that, by the estimation of the eye, the centre of the four rulers seems to coincide with the centre of the intended ellipse, the two upper rulers being parallel to the longest diameter of the curve. Here fix the instrument by pressing the two pins of the ruler P into the frame, and hold it fast, by placing the thumb and fore finger of the left hand upon the nuts NO, leaving the other hand at liberty to turn the circles about by applying the finger and thumb to any opposite two of the small handles f.

Now, by turning the pinion L, remove the drawing pen to one of the marks made for the extent of the shortest diameter of the ellipse; then turn the circles one half round by the handles, and examine if the point of the pen comes exactly to the opposite mark, for the other end of the shortest diameter, if it does not adjust the error one half by moving the pen with the pinion L, and the other half by moving the whole frame on the paper, then by returning the circles back again, the accuracy of the adjustment will be ascertained; for if it meets the former mark, it proves that the circles are in the right centre, and that the compasses are set to the proper diameter for the conjugate axis. Now turn the pen towards the length of the ellipse; and, without altering the compasses or pinion L, slide the circles one upon another by the pinion K, till the point of the pen arrives at the mark made for the length of the ellipse; turn the circles half round to the opposite end, and if they match the mark made there, the adjustment is correct; if not, one half of the error must be corrected, by moving the circles by their pinion K, and the other by moving the whole frame sideways on the paper. To do this, the nuts X, O must be made loose, and then the frame will be at liberty to move. The adjustments being made in this manner, the pen may be suffered to rest upon the paper, and trace round the curve. The Society of Arts rewarded the inventor of this instrument with their gold medal, and have published a description of it in their 21st volume of Transactions; and also a plate of specimens of the curve drawn upon the copperplate by an instrument of the same kind. This instrument, however, has an additional apparatus for dividing the ellipses, when drawn, into any required number of divisions, which shall be the representation of a divided circle, either in true perspective, which artists call the scenographic projection, where the divisions on that side which is nearest to the eye will be larger than those on the most distant, or it will divide in the or-thographic projection, where the eye being supposed at an infinite distance, the divisions on the distant and adjacent sides of the ellipse are equal, and only that difference made in the divisions which is produced from each being viewed with a different degree of obliquity. Numerous specimens of the application of this ellip-tograph may be seen in the Plates of our Work, particu-larly in Block Machinery, and Coining Machines.

Fig. 11 is an instrument, called the geometrical pen, Geometrical which will describe many different curves, though most of them are species of epicycloids. A, B, C are three legs, which form the frame, and support a central axis, ccxxviii. a; upon this a centre, a tube b is fitted to revolve when the finger is applied to the milled circle r; the tube carries an arm d, which supports the wheels e and f, and therefore the centres of these describe circles round the principal axes: g is a cog wheel, firmly fixed upon the lower end of the axis a, and is therefore stationary; but by the revolution of other wheels round it, they have a rotation given to them upon their own axes. The arbor n of the wheel f, has an arm h attached to it, and this at the extremity carries the tube which receives the drawing point k to trace upon the paper. The pencil has therefore a motion round its arbor n, and at the same time this centre is revolving, with a slower motion, round the central axis a. By proportioning the velocities of the movements, a number of curious curves will be found, some similar to that which the moon describes by the compound motion of revolving round the earth at the same time that she is moving in her orbit round the sun. It makes looped figures, resembling stars or flowers, and of any required number of loops or leaves; but as it is impossible to describe these without giving plates of them as examples, we shall not attempt it, but refer our readers to an examination of the machine, or to Adam's Graphical Essays, in which a great number of these figures are given. He ascribes the invention of the instrument to John Baptist Suardi, who enumerates 1273 curves which may be drawn by it. To accom-plish these, many different sized wheels are used, and the revolving arms must be placed at various distances. For this purpose, the wheel g is fitted to the axis, so that it can readily be removed, and another substituted in its place; the wheel e is fitted upon a pin, which slides in a groove cut through the arm d, as shown in Fig. 12 and can be fixed at any part of it by a clamp nut, so as to suit the radius of the other wheels. In like manner, the tube which receives the axis n is fitted on a box which slides upon the arm d, to adjust the distance of the axis n from the central axis; the wheel f, which is fixed upon it, can be readily changed to apply one of a different size, and, lastly, the arm k of the pencil is fitted in a mortise the lower end of the axis n, and is obtained by a screw, by which means the pencil can be removed to any required dis-tance from the axis; and it is by the different propor-tions of these wheels, and the lengths of the arms, that all the above-mentioned varieties of curves can be produced.

Instruments for drawing in perspective are very nu-
merous; but the Camera Lucida, invented by Dr Wo-
Instru-laston, deservedly takes the preference: (See that ar-ticle.) A new and ingenious instrument, invented by Mr Turrell, has been lately rewarded by the Society of Arts, and promises to be very useful to artists. We have not been able to obtain a description of it, as the So-ciety has not yet published their account of it, but we shall probably have this in our power under the article Perspective. (J. P.)
DREAMS must be so familiar to our readers, that it seems superfluous to define them. They are among the most curious phenomena of the human mind; and at the same time, the most difficult to be satisfactorily explained. The interest which they have excited in all ages, both among the vulgar and ignorant, and among philosophers, has been very great and general. The earliest authentic records of history inform us, that dreams were regarded as supernatural or prophetic; and this idea has descended, at least among the common people, even to our own times. The Greeks and Romans paid particular attention to them. They divided them into five sorts: the first distinction, as given by Macrobius, refers to what is properly called a dream, *somnum,* this he considers as a figurative and mysterious representation, which requires to be interpreted. The second species relates to what is termed vision, *visio,* which was, when any one saw that which afterwards came to pass in the same manner that it was foreseen. The third sort, the ancients conceived to be oracular, *oracleum,* this they described as taking place, when in sleep any venerable person, or deity, denounced what was or was not to happen, or what should be done or avoided. All these sorts of dreams were supposed to arise under the influence of inspiration; and in order to procure them, it was usual to lie down to sleep in the temple of some deity. The fourth sort was the *insomnium,* *evocius,* this Macrobius represents as proceeding from the solitude of an oppressed mind, body, or fortune, which having harassed us when awake, affects us when asleep; and respecting this sort, the ideas of the ancients seem to have been tolerably just and rational; for, not regarding them as arising from the influence of inspiration, they endeavoured to trace them to natural causes. These dreams, however, they regarded as deceitful and vain. The last sort is called *phantasm* by Macrobius, and *visio* by Cicero. According to these authors, it took place between waking and sleeping; as in the first clouds of sleep, when the person who begins to doze, thinking himself awake, imagines that he sees forms differing in shape and magnitude from natural objects, rushing upon him, and wandering about. Under this class, the ancients placed the *epithalides,* or *night-mare.* Some other of the ancient writers on dreams divided them only into two classes, plain and allegorical; the former exhibiting things in their proper form, *epiesiugia*; the latter, such as intimated circumstances under similitudes. Besides Macrobius and Cicero, several others of the ancients wrote on the subject of dreams, either directly and fully, or incidentally, as Plutarch, Zeno, Cleanthes, Chrysippus, Babyloniurn, Diogenes, Antipater, Poseidonius, Aristotle, &c. The exposition of dreams was reduced by them to scientific principles, and practised by men who engaged in it as a profession. Some writers distinguish between *dreamers of dreams,* *onmatheia,* and *expositions of dreams,* *onmatheoi.* It appears from a passage in Plutarch's life of Aristides, that certain tables were used for the interpretation of dreams; he speaks of Lysimachus, a grandson of Aristides, who, sitting near the temple of Bacchus, gained his livelihood by it. But the most laborious and solemn trifier on this subject among the ancients was Artemidorus, who lived in the reign of Antoninus Pius. His whole life seems to have been spent in going about collecting dreams. The fruits of his labour are still extant, in a large work entitled *Ostroecritus.* A person still more singularly devoted to the study of this sub-
ject was Jonianus Magnus, a Neapolitan, who lived in the 15th century, and was the instructor of the celebrated Sanagorius. Magnus is deservedly known to the classical scholar, as having essentially contributed to the revival of the Latin language; but in his own time he was much more celebrated for his skill in the interpretation of dreams. Besides Sanagorius, Alexander ab Alexandro was one of his disciples; and he informs us, that every morning the house of Magnus was crowded with persons of the highest rank, who came to tell him their dreams, in order that he might interpret them; and that his interpretations were not obscure and ambiguous, but clear and direct. He seems to have obtained a very easy and ample livelihood by this profession. The superstition of the Romans respecting dreams seems to have been at its height in the time of Augustus. This emperor not only observed the time of the year when his dreams were least favourable and most uncertain, but on a certain day of every year, in consequence of a vision, he begged publicly, stretching out his hand to those who reached him a few *accet,* and in his reign a law was passed obliging all who had dreamt anything respecting the state, immediately to make it known, either by a placard, or by the public crier. The consequence was, that dreams multiplied so excessively, that it was necessary to adopt it as a principle, that none which related to the state should be regarded, unless they were seen by magistrates, or at least by more than one individual. It has been remarked, that, with respect to these superstitions, the most polished nations of antiquity approached very nearly the Indian tribes of North America. "All the marches of the Indians are regulated by the dreams of the old warriors, who, under this pretence, often convey information, gained by spies, to the young men; but it must be observed, that they only pay attention to dreamers of established character." See Ferrar on "Popular Illusions," p. 28.

But though the superstitions notions which the ancients entertained on the subject of dreams, naturally and necessarily dissipated or disabled them from investigating their real cause and phenomena so clearly and fully as they might otherwise have done, yet some of them have offered hypotheses to account for them, certainly not less philosophical than many which have been brought forward by modern writers. These hypotheses, of course, resulted from, or rather formed, a part of their general system of physics and metaphysics. We shall briefly notice the most celebrated. According to Epicurus, our sensations are the effects of the different organs which the soul, while united to the body, is capable of employing, and of the different properties and qualities of external objects. These are rendered sensible, by means of certain species, or images, which are perpetually passing, like thin films, from bodies, in form similar to the surfaces of the bodies themselves, and striking upon organs fitted to receive them. The species, or images which produce these effects, are inconceivably small, and therefore do not, in passing away, perceptibly diminish the body; and from the innate tendency to motion in the atoms of which they are composed, they fly with inconceivable velocity from the object to the organ of sensation. From this general doctrine, Epicurus concluded, that sleep was produced, when the parts of the soul which, at other times, were diffused through the body, were repressed or separated by the action of the air, or of food; and that dreams were the effect of images, ca-
DREAMS.

1. In dreams every thing appears real; while our dreams continue, every thing which we see or hear— all the events in which we take a part, our sentiments, feelings, and passions, are exactly similar to those of real life. Our existence, in short, seems to be renewed, if, after a deep and sound sleep, we begin to dream. Addison has described the general fact with no less truth than elegance: "The soul in dreams converses with numberless beings of her own creation; and is transported into ten thousand scenes of her own raising: she is herself the theatre, the actor, and the beholder."

2. Our opinions, feelings, sentiments, and habits, in dreams, have a strict relation to our real character: we do not dream that we entertain or express those opinions which we do not actually believe; nor that we experience those feelings, to which we are strangers or adverse while awake.

3. In our dreams, we seem to have the idea of time. As this is doubted by some philosophers, it may be proper to adduce the particular facts on which it is grounded. In our dreams, we frequently anticipate or dread future events; and we experience regret for those that are past; we also consider one event as the cause of another; but, in all these cases, the idea of time is evidently implied.

4. We reason in our dreams. We frequently seem to hold an argument with others. "We address them in harangues, and write whole pages with greater celerity, than an author, in his happiest hours of inspiration, can connect as many sentences. Degrees of good and evil are compared in the same manner as in the business of the day. We conceive ourselves pursued by an enemy, with obstacles on every side, as rocks and rivers. We observe the dangers of each, and we choose that path which appears to us least dangerous." (Brown on the Zoology, p. 553.) Of these facts every one's experience must convince him; but there are others not so common, but which nevertheless seem well established; which prove that our inventive and reasoning powers are active and vigorous in our dreams. Condorcet told Cabanis, that while he was engaged in some abstruse and profound calculations, he was frequently obliged to leave them in an incomplete state, in order to retire to rest; and that the remaining steps, and the conclusion of his calculations, have more than once presented themselves in his dreams. According to Cabanis, Franklin's ideas respecting the perfection of the mental powers during dreams, were still more extraordinary than those of Condorcet; for that philosopher assured him, that the bearings and issue of political events, which had puzzled him while awake, were not unfrequently unfolded to him in his dreams. (Cabanis, Reap. Physique, et du Moral de l'Homme, tom. ii. p. 547.) And the writer of this article is acquainted with a gentleman of a very speculative and inventive turn of mind, to whom the idea of making a flexible rudder to ships, which, like the tail of fishes, might not only direct, but assist their course, was presented in a dream.

5. Our dreams are often wild and inconsistent.

6. Most people must have experienced in their dreams,
that absent or dead friends, the idea of whom they have in
vain endeavoured to recall while they were awake,

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have appeared most distinctly and permanently; the
impression of them is strong and vivid, and while the
remembrance of the dream continues, their image is
present to the mind; but as soon as the recollection of
the dream vanishes, or becomes faint, that image can
no longer be called up, at least so distinctly and per-
manently.

7. Our sensations of pain and pleasure are fre-
quently very strong during our dreams, as we have already
remarked. Our peculiar character remaining in our
dreams, all the habitual opinions and feelings of our
mind are called up by the same circumstances, that
would excite them when we are awake; but in many
cases, our opinions are expressed with more vehemence,
and our feelings are more acute. Perhaps our sensa-
tions of horror are much stronger in dreams than they
ever are in reality; most people, we imagine, can at-
test the truth of this remark from their own experi-
ence.

8. The rapidity in the succession of our thoughts, or
of the transactions in which we seem to be engaged, is
often very astonishing, "in so much so, that when we
are accidentally awakened by the jarring of a door, which
is opened into our bed-chamber, we sometimes dream
a whole history of thieves or fire, in the very instant of
awakening."—Zoonomia, Section 18.

9. There is a vast variety of scenery, novelty of com-
bination, and distinctness of imagery, in our dreams;
and it may be remarked, that they consist chiefly of
visible imagery, and what we appear to see in our
dreams, impress us more strongly than what we appear
to hear or do. While we are awake, vivid impressions
are constantly made on the optic nerve; hence they be-
come more frequently and strongly the objects of our
dreams. It may be remarked in this place, that, ac-
cording to Parkehurst, the Hebrew word, which signifies
a dream, implies broken parts or fragments, composed
of ideas or images received by our senses, particularly
by our sight, while awake.

10. We are seldom surprised at the wildness or in-
consistency of our dreams. Some authors contend that sur-
prise never takes place: but this is evidently a mistake;
though it must be admitted, that those things which
would excite the strongest surprise while we were
awake, are generally regarded in our dreams without
any feeling of that nature. We are, indeed, very sel-
dom surprised, either at the inconsistencies in our
dreams, or at their presenting to us objects, which,
while awake, we should immediately know could not
appear to us. If the image of an absent or dead friend
appear in our dreams, we feel no surprise; we ex-
perience no tendency to doubt the reality of the appar-
erance; we converse with him; we seem to hear him
speak, and see him act, as if he were actually present
or alive; but if he utter sentiments, or perform actions,
different from those to which we have been accustomed
from him, then surprise is undoubtedly felt. But, per-
haps, it is still more extraordinary and inexplicable
phenomenon, that the inconsistencies and contradic-
tions in our dreams themselves should so seldom excite
surprise; that we should not feel surprised at the con-
tradiction between reality and our dreams, may easily be
conceived; but as we undoubtedly compare and reason
in them, it is extraordinary that the inconsistencies be-
tween parts of them should not be noticed, and excite
surprise; and yet scarcely any of the phenomena of
dreams are better established than the one to which we
are now advertung.

11. We have already observed, that Aristotle noticed
the fact, that we often dream that we are dreaming: in
many cases, however, where this is supposed to take
place, it is very probable that we are actually awake;
but for so short time, and in such an imperfect manner,
that we confound our waking thoughts with our dreams.
Smellie says, that men, who have the misfortune to be
subject to disagreeable dreams, learn by experience to
know that they are dreaming. He adds, "when ter-
rorized with impending danger, and even death, I have
often said to myself, 'Don't be so much alarmed: you
have been in the same, or in similar situations, which
were uniformly discovered to be dreams.' This species
of dormitory reasoning greatly alleviates the pain, and
not unfrequently gives an opposite direction to the
imagination." (Smellie's Philosophy of Natural His-
tory, vol. ii. p. 372.) There can be little doubt, that
what he calls dormitory reasoning was exercised du-
ing a moment of short and imperfect vigilance.

12. When our dreams are disagreeable, we seem to
be sensible of strong and painful efforts to free our-
selves from them, either by endeavouring to remove
from the scene where the disagreeable circumstances
occur, or (as it were) by changing our thoughts. Of
this latter mode of attempting to free ourselves from
unpleasant dreams, most people must have had ex-
perience; but whether it actually takes place while we are
asleep, or during a short interval of imperfect vigilance,
it is not easy to determine. With respect to our en-
deavours to quit the scene of unpleasant occurrences,
there can be no doubt that they take place in our
dreams; and it is equally true, that these endeavours
are for the most part unsuccessful; and we experience,
in our dreams, the painful impression, that, in spite of
all our efforts to the contrary, the most afflicting, dis-
agreeable, or horrid dreams continue to haunt us.

13. When we dream that we change our place, we
seem to be transferred by a kind of sailing or flying
motion. This, however, is not always the case: in
some instances, we are suddenly transported from one
place to another, without any intermediate impression
of the mode by which it takes place; while at other
times we dream that we remove from one place to
another by the usual modes of conveyance. When-
ever, however, the change of place is great and sud-
den, it is either accompanied with the sensation of a
sailing or flying motion, or seems to be effected in-
stantaneously, and without any motion.

14. We not unfrequently dream that we are falling
from a great height; and we seem to experience that
rapid whirling of the brain and senses, which must
take place when such a circumstance actually occurs;
but we believe it very seldom happens, that any person
under the influence of such a dream, ever seems to ar-
rive at the bottom: he feels himself moving in the air;
he even reflects on the consequences of his fall; he
shudders with horror; but before he seems to arrive at
the bottom he awakes.

15. Dr Darwin observes, "that if we sleep in the
daylight, and endeavour to see some object in our
dream, the light is exceedingly painful to our eyes;
and, after repeated struggles, we lament in our sleep
that we cannot see it."—When we are forcibly waked
at midnight from profound sleep, our eyes are much
dazzled with the light of the candle for a minute or
two, after there has been sufficient time allowed for
the contraction of the iris; but when we have dreamt much of visible objects, this accumulation of sensorial
power in the organ of vision is lessened or prevented, and
we awake in the morning without being dazzled with the
light, after the iris has had time to contract itself." (Zoönomia,
sect. xviii.) We give this circumstance on the
authority of Dr. Darwin; if correctly stated, it is
confirmed by no means general; but, as it is adduced
to support a particular theory, we should be disposed
to question its accuracy.

16. Our dreams more frequently relate to the scenes
and occurrences of childhood and early youth, than to
those of later years. This is the case, whenever no
particular circumstances connected with our bodily sen-
sations, our mental habits, or events in which we have
been deeply interested, do not give rise to them. Our
general dreams certainly present to us, in most in-
stances, what has happened in our youth. In this re-
spect they resemble the memory of old men, which is
usually more vivid and rich in the scenes and occur-
rences of early youth than of later years. Mr. Stewart
remarks, that in youth our dreams commonly involve,
in a much greater degree, the exercise of imagination,
and affect the mind with much more powerful emotions,
than when we begin to employ our more mature faculties
in more general and abstract speculations." (Philoso-
phy of the Human Mind, 4to edit. p. 392.) Hence, as
our dreams partake of our passions as well as our char-
acter, the dreams of those who are much engaged in
philosophical studies, relate chiefly to reasoning and
speculation, where the influence of particular circum-
stances does not operate.

All these facts regard the dreams themselves; but
there are others respecting the evident and immediate
causes of dreams, or which relate to our impressions
and feelings, when we awake after dreaming, which
require to be stated.

1. Our dreams are often caused by bodily sensations;
It has been already noticed, that Aristotle remarked,
that a slight heat applied to the feet, when we are asleep,
often produced in our dreams the feeling of burning
coals; and Mr. Stewart relates a similar fact respecting
a friend of his, "who having occasion, in consequence
of an indisposition, to apply a bottle of hot water to his
feet, when he went to bed, dreamed that he was making
a journey to the top of Mount Etna, and that he found
the heat of the ground almost insupportable. Another
person having a blister applied to his head, dreamed that
he was scalped by a party of Indians." Sometimes sen-
sations give rise to dreams in a more direct manner,
and more similar to themselves: Smellie mentions a
student of medicine in the University of Edinburgh,
who was accustomed to talk and answer questions in his
sleep; in consequence of which habit, some of his
friends whispered into his ear the name of a lady to
whom he was attached: at first he talked incoherently;
but soon his dreams evidently related to the object of
his affections: he thought he was under her window,
and he upbraided her for not appearing to him, as she
had frequently done before; at length becoming impa-
tient, he started up in his sleep, and threw whatever
he could lay hold of, against the opposite wall of his
chamber, evidently supposing it was the window of his
mistress's room: when he was told next day what had
happened, he said he had only a faint recollection of
having dreamed about his mistress. (Smellie, vol. ii.
p. 398, 399.) Beattie relates a still more striking instance
of the effect of sensations in producing dreams: A gen-
tleman in the army, was so susceptible of audible im-
pressions during his sleep, that by speaking in his ear,
his friends could make him dream of what they pleased:
One night they carried him through all the process of a
duel, and at last, putting a pistol in his hand, he actually
fired it off, and was awakened by the sound. (Beattie
on Dreams.) If the bed-clothes fall off while we are
asleep, we frequently dream that we are naked. In
some cases, impressions on our senses appear to mix
with our dreams; we frequently find the ineffectual
calls that are addressed to us, as well as other sounds,
mixing with them.

2. Closely allied to this cause of dreams, are the sen-
sations we experience from the state of the viscera, sto-
mach, &c. Perhaps the most singular circumstance
connected with the operation of those causes, is,
that an overloaded stomach sometimes produces dreams, in
which the person fancies himself strangled with reple-
tion, and at other times he dreams that he is dying of
hunger; but persons who have been deprived of their
usual food, generally dream of eating: Trench relates,
that being almost dead with hunger, when confined in
his dungeon, his dreams every night presented to him
the luxurious and well-plastered walls of Berlin, from
which he thought he was about to satisfy himself.
There are other causes, evidently connected with our
sensations, which give rise to dreams: these posture,
particularly too low, if we have too
many bed-clothes, or if any thing happens to obstruct
our respiration. It is well known also, that opium,
and other soporifics, if they do not produce very sound
sleep, give rise to dreams. Medical men remark, that
some tempers are more subject to dreams than
others; the sanguine more frequently than the phleg-
nic.

3. The character of our dreams is greatly influenced
by our disposition; hypochondriacal persons have often
anxious dreams, and cheerful persons cheerful dreams.

4. Our state of health seems to have considerable
effect, not only in producing dreams, but in giving
them their particular character. This fact is sufficiently
well known; and medical men remark, that acute
diseases, particularly fevers, are often preceded and in-
dicated by disagreeable and oppressive dreams.

5. Our dreams are influenced by our thoughts and
employments during the day, as well as by our general
habits of association and action. There are probably
few mathematicians who have not dreamt of an in-
teresting problem; and who have not even fancied that
they were investigating it with much success; the in-
stance of Condorcet has been already noticed. In like
manner, "those whose ambition leads them to the study
of eloquence, are frequently conscious, during sleep,
of a renewal of their daily occupations." Stewart, p.
330.

6. The particulars which pass before us in a dream
are often forgotten, till at a distance of time some anal-
ogous idea or transaction recalls them.

7. We are apt to confound the impressions we have
received in our dreams, with the thoughts and events
of real life; in some instances so completely, that we
are unable to determine whether we remember be
a dream or not.

8. Our mental feelings, as well as our bodily sen-
sations, to which dreams give rise, often remain in full
force for some time after we awake: Of this, so far as
respects bodily sensations, all must be sensible, who
have suddenly awakened from dreams of impending
danger or horror; and the same is the case, where the mental feelings of indignation or sorrow have been excited in our dreams, we are conscious of them for some time after we awake.

It is not easy to determine whether all men dream; it is more certain that some men are more subject to dreaming than others. Locke is of opinion that most men pass a great part of their sleep without dreaming: he adds, "I once knew a man, that was bred a scholar, and had no bad memory, who told me, he had never dreamt in his life, till he had that fever he was then newly recovered of, which was about the five or six-and-twentieth year of his age." (Locke, Book II. Chap. i. § 14.) The probability, however, is, that all persons dream more or less; since some of the numerous causes which produce dreams must operate in some degree, and at some periods of their lives, on all men; besides dreams are apt to be forgotten; and those who, by some subsequent occurrence, or train of thought, are reminded of their dreams, would, if this had not taken place, have conceived that they had not dreamt. It is more certain that very young children do not dream; at what age they generally begin has not been ascertained. Many animals undoubtedly dream: this fact was known to the ancients.

A much more curious and interesting question is, of what kind are the dreams of the blind, and of the deaf and dumb, especially of the blind? for we have seen that visible imagery constitutes by far the largest and most important portion of our dreams. Unfortunately on this subject we have very few facts; from these, however, we shall select two, which are given on good authority, and one of them rather in detail. Mr Bew, in his Essay on Blindness, published in the first volume of the Manchester Transactions, says, that a blind gentleman with whom he conversed, clearly proved, that in his dreams, he was conscious of the figure, though he could not distinguish the varieties of the human countenance; and that from the confused efforts he made to explain himself, it might be perceived that he felt himself alarmed with new sensations, that bore a strong relation to our ideas of light and colour, but which means he was unable to describe, because he could not fix on any comparative idea whereby to explain himself. These dreams were always painful, and the impressions extremely transient and unsatisfactory.

The other fact relates to Dr Blacklock. Dr Reid asked him if he had any idea of light? And upon his replying in the negative, he enquired if there was any difference between his ideas of persons and objects when he dreamt, and those which were excited while awake? Dr Blacklock replied the difference was great; but at first he was unable to explain it. At last, with some degree of exultation, he exclaimed, "Now I have it!" When he was awake, he could distinguish persons three ways; by hearing them speak, by feeling their head and shoulders, or by attending, without the aid of speech, to the sound and manner of breathing. But in sleep, the objects which presented themselves were more vivid, and without the intervention of any of the three modes, he had distinct perceptions of distant objects, both animated and inanimate. Being asked by what means he thought these impressions were conveyed to him? he replied, that he imagined his body was united to theirs by a kind of distant contact, which was effected by the instrumentality of threads or strings which proceeded from their bodies to his own, and that mutual ideas were conveyed by vibrations of these strings. (Smellie, p. 398, 399)

Having thus detailed the principal facts connected with dreaming, we shall conclude this article with a very brief summary of the opinions and theories which have been advanced by modern philosophers, either respecting the cause of dreams in general, or in explanation of some of its phenomena.

1. Wolfius, and after him M. Formey, maintain, that dreams in all cases are caused by impressions on the organs of sense. This theory has been confounded with that of Aristotle, from which, however, it differs very materially. The Grecian philosopher believed, that all impressions on the brain were conveyed by means of the senses, and that these impressions being called up again during sleep, produced dreams; whereas Wolfius and M. Formey are of opinion, that dreams are occasioned not by renewed impressions, but by direct impressions on some of the senses during sleep. That our dreams are caused or modified by our bodily sensations while we are asleep, we have already seen; but it does not hence follow, that in all cases they are produced in this manner; on the contrary, dreams frequently occur when we have no reason to suppose that any impression has been made on our organs. This hypothesis, therefore, is completely gratuitous and un-founded.

2. Sir Henry Wotton seems to have been of opinion, that during sleep the soul exercised a freer and wider range; or, as he expresses it, it had then a "moredetector operation." This notion, borrowed from the ancients, and to which we shall afterwards have occasion more particularly to advert, will, we apprehend, in the present day gain few believers. Sir Thomas Brown, however, entertained a similar opinion. The sumbmers of the body, according to him, were but the working of the soul; "the ligation of sense, but the liberty of the soul;" and he appears to have grounded this opinion on the fact, "that our waking conceptions do not match the fancies of our sleep." (Helieuale Wottoniana, and Religio Medicci, tom ii. p. 11.)

3. Mr Hobbes thought, that in all cases dreams were produced either by some particular disorder, by a general bad state of health, or by unpleasant bodily sensations. He has evidently fallen into the same erroneous mode of reasoning as Wolfius and M. Formey; that is, he has drawn a general conclusion from particular facts. Disease, an unhealth or bad state of the body, and unpleasant bodily sensations undoubtedly give rise to dreams; but hence it by no means follows, that these are the only causes of dreams. Mr Hobbes mentions, that lying cold produces dreams of fear. In some cases it may; but, in other cases, it either gives rise to no dreams, or to dreams of a different character.

4. Andrew Baxter, the author of Matha, entertained a very whimsical theory on this subject. He believed that dreams were produced by the influence of unembodied spirits on the mind during sleep. This theory he adopted, in consequence of our dreams appearing to be obstructed upon us against our will, and all our efforts, by some external cause. (Baxter on the Soul; chap. x.)

5. Haller, and some other physiologists, are of opinion, that dreams never accompany sound sleep. They therefore suppose them to result from some strong stimulating cause, or some forcible impression excited by the influence of undigested food.

6. Locke does not, strictly speaking, endeavour to account for dreams. He only explains what he conceives to be their nature, and that incidentally and briefly, "The dreams of sleeping men are, as I take it, all,
made up of the waking man's ideas, though for the most part oddly put together." And again, "Dreaming itself, is the having ideas (whilst the outward senses are stopt, so that they receive not outward objects with their usual quickness,) in the mind, not suggested by any external objects or known occasion, nor under any choice or conduct of the understanding." (Book ii. ch. i. § 17, and ch. xix. § 1.)

Opinion of Bonnet.

7. The theory of Bonnet is similar to that of Sir Henry Wotton; but as the character of the former writer stands high for physical and metaphysical knowledge, it may be proper to state and examine it more fully than we did when we noticed it before. Bonnet inquires how it happens, that the perceptions of the soul during sleep are so vivid? To this he replies, that we can discover the cause only in the silence of the senses. While we are awake, the senses mix in a certain degree with all the operations of the soul; but when we go to sleep, the perceptions from without grow feeble, and the perceptions from within become more strong and vivid; and as soon as the senses are hulled into profound sleep, then the soul is perfectly awake and busy, and renders us conscious of its operations in what we call dreams. Besides this general theory to account for dreams, Bonnet endeavours to explain the singularities and inconsistencies which take place in them. Notwithstanding the great power of the senses, and the unfettered vigilance of the soul, it sometimes happens that external sensations, though feeble, mix even in profound sleep, with the more vivid operations of the soul, and hence all the inconsistencies and vagaries of our dreams. The following remark, though rather fanciful, deserves quotation: "Since then our dreams, in general, are only the representation of objects, which have interested or occupied us while awake, let us endeavour so to regulate our imagination, that we may only have rational dreams; thus shall we be enabled to prolong the duration of our intellectual existence, (de notre etre pensant)" (Contemplation de la Nature, chap. vii.) It is unpleasant to deal hardly with a theory supported by such a man as Bonnet, in whom amiableness of disposition, fervency and at the same time rationality of piety, and a very minute and extensive knowledge of nature, always brought forward for the most devout and sublime purposes, were united in an uncommon degree; but his theory of dreams does more credit to his imagination than to his philosophy.

Opinion of Hartley.

8. Hartley endeavours to explain the principal phenomena of dreaming, by his peculiar theory of vibrations. That the scenes in them are mistaken for real, is owing, according to him, to the exclusion of real impressions with which they may be compared, and to the increased vividness in the trains of visible ideas. Dreams are wild and inconsistent, because the brain is in a very different state from that of vigilance, and the vibrations of the stomach being propagated to the brain, produce a succession of ideas, which depend indeed upon association, but are very different from those which would take place in a state of vigilance. We are not offended at inconsistencies, because those associations which should lead us to notice them are as it were asleep; but if the state of the brain be such as to favour the production of ideas of anxiety and perplexity, apparent inconsistencies give us great uneasiness. When persons walk and talk in their sleep, the vibrations descend into the motory muscles, at the same time the brain is oppressed, and they have no memory. Dreams are soon forgotten, on account of their incoherence, and of the change which takes place in the brain in passing from sleep to vigilance. From this specimen of the mode in which Hartley attempts to account for the phenomena of dreaming, it is evident, that what he deems explanations, are either mere emendations of the facts to be explained in different words, or completely gratuitous and unphilosophical. (Hartley on Man, Part i. ch. 2. § 5.)

9. Dr Darwin has directed his attention rather to the Of Darwin state of the mental faculties in sleep and dreams, than to their cause. He is of opinion that volition is suspended, and that sensation continues. We shall briefly notice some of the principal facts and arguments by which he endeavours to support this doctrine, and the very acute and forcible objections which have been made to it by Dr Thomas Brown, professor of moral philosophy in the university of Edinburgh, in his Observations on Zoornia. To the general doctrine of Darwin, that the power of volition is totally suspended, Dr Brown objects, that as the trains of ideas which constitute our dreams were originally associated when we were sensible of external objects, and consequently when volitions formed part of the train, if the laws of association continue during our dreams, (which Dr Darwin does not deny,) volitions should be induced, whenever the preceding motion of the train exists. If volition were suspended, our dreams could only occupy a few minutes of our sleep, since our associations would be suddenly broken off at that part of the train which was originally succeeded by volition; for the motion consequent on volition could not be produced, according to the known laws of association, unless volition existed. Dr Darwin says, that "during the suspension of volition, we cannot compare our other ideas with those of the parts of time in which they exist; that is, we cannot compare the imaginary scene which is before us, with those changes of it which precede or follow it, because this act of comparing requires recollection or voluntary exertion; but we evidently have the idea of time in our dreams, and as we reason in them, or, in other words, perceive the agreement or disagreement of ideas, recollection or voluntary exertion cannot be suspended. The instances which he adduces of motions of the larger muscles, the indistinct sentences which are sometimes uttered, and the confused barking of sleeping dogs, it is well remarked by Dr Brown, prove that the suspension of the voluntary power is not necessary to sleep. Indeed, besides those operations of the body or mind of which we dream, and which imply volition, we are frequently directly conscious of exerting it in our dreams, especially when they are unpleasant. That this exertion of volition is not followed during sleep by the same effects as it produces when we are awake, is no proof that it does not take place. (Zoornia, vol. i. § 18.) Brown's Observations on Zoornia, § xi.)

10. Professor Dugald Stewart has considered dreams of Stewart in a more cautious and philosophical manner than any other writer on the subject. He is of opinion, that "the power of volition is not suspended, but that the will loses its influence over those faculties of the mind, and those members of the body, which during our waking hours are subjected to its authority." In support of the latter part of this doctrine, he argues, that if the influence of the will be suspended during sleep, all our voluntary operations must also be suspended, such as recollection, reasoning, &c. That our recollection is suspended, is evident from our dreaming of seeing persons who are absent or dead, and from our confounding times and places. To the objection that we reason in our dreams, he replies, that these reasonings...
are carried on independently of any exertion of the will. His second argument is, that if the influence of the will during sleep be suspended, the mind should remain passive; and that this is the case in our dreams, has always been considered as one of the most extraordinary circumstances with which they are accompanied. It is indeed a matter of vulgar remark, that our dreams are in every case involuntary on our part; not that we do not exert volition in our dreams, especially, as has been already stated, to remove unpleasant images, but that the influence of our will is then suspended. Besides, Mr. Stewart argues, that, if his opinion be well founded, the conceptions which we form during sleep of sensible objects, will be attended with a belief of their real existence as much as the perception of the same objects is while we are awake; and this is an undoubted and well known fact. (Stewart's Philosophy of the Human Mind, 4to edit. chap. v. sect. 5.)

Of Cullen.

11. Cullen was the first who pointed out the constant and regular resemblance between dreams and delirium; and who proved, that, at the commencement, and during the continuance of sleep, the different senses and organs sleep successively, and in a very unequal degree; and that the partial excitation of those parts of the brain, which correspond to them, by disturbing the harmony of its functions, produces irregular and confused ideas, which have no foundation in reality. This doctrine of Cullen has been adopted by Cabanis, who enters into it more minutely and fully. As his remarks on the subject are, we believe, very little known in this country, we shall conclude this article by a brief abstract of them, so far as they regard, and in his opinion explain, the phenomena of dreams. Before, however, we give his observations on dreams, it will be proper to attend to what he says respecting sleep. In illustration of Cullen's doctrine, that the senses and organs fail to sleep successively, he observes, that the muscles which move the arms and the legs relax, and cease to act, on the approach of sleep, before those which sustain the head; and these before those which support the back. At the period when the sight, under the protection of the eye-lids, no longer receives impressions, all the other senses preserve their sensibility entire; the sense of smelling does not fail asleep, till after the sense of taste; the hearing, till after the sense of smelling; and the sense of touch after the hearing. This last sense appears to be awake, even during the most profound sleep; for we exercise it, when we change our position in bed, which often takes place without in the smallest degree disturbing our sleep. Nor do the senses sleep equally profoundly. The sense of taste and smelling awake the last: the sight seems to awake with more difficulty than the hearing; the smallest noise will sometimes awake somnambulists, on whom the most vivid light makes no impression, though their eyes are open. The sleep of the sense of touch is more easily disturbed than that of the hearing; the same person who would not be awakened by noises very sudden and loud, starts up immediately if the soles of his feet are tickled in the slightest degree. The same is the case with respect to the internal organs; the viscera fail to sleep one after the other, and sleep with different degrees of profundity.

Of Cabanis.

The truth of these observations, Cabanis confirms by what happens to somnambulists, and cataleptic patients. He also remarks, that in different persons the different muscles seem to fall to sleep at different periods: some can sleep on horseback; with them the voluntary power over the muscles of the back is retained and exercised during sleep; others sleep standing, or even while they are walking. Hence this author infers, that volition exists and is exercised during sleep; and the accuracy of it he thinks is further proved by the facts, that a person while in this state puts up his hand to drive away the fly that may have settled on his face; pulls the bed-clothes upon him; and, as was before observed, changes his position in bed.—But besides these facts respecting the successive order, and the different degrees, in which the organs and the senses sleep, there is established among them, while they are in this state, new sympathies and relations, with respect to the impressions which peculiarly belong to them. Hence their influence on the brain is different from what it is when we are awake; thus, the process of difficult digestion gives rise to different images in the brain during sleep, from those which it would produce in our waking state.

Having premised these observations, Cabanis next enquires, by what kind of impressions, and by what state of the animal economy, are dreams produced? To this he replies, that they evidently take place when the action of the external senses is suspended; that of most of the internal organs moderated, but in a different degree; the sensibility of some of them being even increased: in this state, a large portion of the nervous influence is concentrated in the brain, which is given up either to its own peculiar impressions, or to those which it receives from the internal organs, which still exert their influence without the intermixture of impressions from external objects, which might give them order and consistency. The compression of the diaphragm on the process of digestion often recalls, in our sleep, forgotten events, or persons, or trains of reasoning, by acting on that part of the brain where the impressions of these objects were formerly excited; for it is not true, that our dreams relate only to those things which have excited our attention or interest while we are awake. Such, no doubt, from the power of association, very frequently give rise to them; but in many cases they can be accounted for only on the supposition that the brain, during sleep, is given up either entirely to its own peculiar impressions, or to those impressions which are excited or modified by the action of such organs as still retain their power. On this theory we shall only remark, that even if it is quite intelligible and satisfactory to the physiologist, it will not be received with much deference by the metaphysician. See Rapports du Physique, et du Moral de l’Homme, par P. J. G. Cabanis, toin. ii. p. 594—551. (w. s.)

DREDGING, is an operation of the utmost consequence to the improvement of navigable canals, rivers, docks, harbours, &c. and is performed by means of machines, of various construction, so contrived as to loosen and lift the mud, gravel, or other materials, which are occasionally deposited, or may have been the original stratum, under water.

As much depends on local situation with regard to dredging machines, like many other branches of civil engineering, it is difficult to give precise information on the subject, and a great deal must be left to the persons who are intrusted with the immediate direction of the works to be performed.

We shall endeavour, however, to give such general ideas, and accompany these with drawings of one of the most improved and powerful machines now in use in this kingdom, as, we hope, will render this article very valuable to the practical engineer.

We believe dredging under water was first resorted to by the Dutch, for clearing the bars or entrances to
their harbours and navigable canals. These early machines were not contrived for lifting stuff, but only to loosen it, that the sluices which were constructed for the purpose of scouring might be more effectual. The machine consisted of large bars or prongs, like a number of forks, placed vertically in a frame, and being fastened to a barge placed in the line of the sluices, the whole was impelled forward by means of the current, and caused a more powerful scour.

The first kind of dredging machines employed to any extent in Britain, consisted of a large plate of iron, about four feet long and eighteen inches deep, and sharpened on the under edge. To each end of this plate of iron, a plank of hard wood was fixed to tenons cut in the iron, the sharpened edge of iron projecting about four inches below the wooden sides, which should be about five long, tapering to ten inches deep at the point, where a bar of iron is fastened to keep the two ends asunder. The whole formed something like a box without bottom or top, eighteen inches deep at the one end, and ten inches at the other. From the two extreme points of the wood a chain is fixed for attaching the principal working rope or chain.

In order to put the machine in motion, it is requisite to have a punt moored on each bank of the river directly opposite, and on each of these punts a capstan or windlass, the one for drawing across the empty dredge, and the other for bringing it back. In the course of its passage, the dredge is generally filled, and by means of the capstan it is drawn so high up that men at low water can remove the stuff with shovels. Where the shiftings are not frequent, a capstan or windlass may be placed on the bank of a river, and the operation performed as before. But as the method by the machine just described, is very tedious where dredging of great extent is required, it is now little used except in levelling foundations under water, for which it is well adapted, if the material is soft sand or mud; but where there is stony gravel, it is necessary, in place of having the mouth of the dredge straight, to have it made with bars of iron curving towards the under edge, and placed about four inches apart, when stones of considerable size may be brought to the side, and removed in the manner we have already noticed. Machines constructed agreeably to the foregoing principle, have for many years been employed in deepening the navigable part of the river Clyde between Glasgow and Dumfries.

We come now to the operation of dredging, which is performed by the bag and spoon. This kind of dredging has been carried on to a considerable extent under the direction of the Trinity-house at London for deepening the river Thames, and also for obtaining ballast to the vast number of ships which frequent that noble river. The convicts at Woolwich have been long employed in the same manner for deepening the river, and obtaining stuff for embankments and other government works at Woolwich.

The spoon consists of a ring of malleable iron, two feet wide, and two feet four inches deep; sharpened and steadied on the under side four inches broad for about one-third of its circumference, and pierced on the inner edge with holes for the lacing of the bag. The remainder of the ring is of round iron one inch and a half diameter, and on the upper side, or that opposite to the mouth, a hose must be welded to receive the pole or handle, which, to a spoon of the above size, should be from four to five inches diameter; the length of this pole or handle will always be regulated by the depth of water. From each side, about half way up the spoon, a chain two feet and a half long is fastened, and these chains come together by a small ring in the middle, to the place where the working rope is made fast.

The bag is generally made of strong tanned leather. Bag of the size of the spoon at the mouth, narrowing considerably towards the bottom, that it may be the easier discharged. It is about three feet and a half deep, and is laced to the spoon with leather thongs, and perforated to allow the water to escape.

In order to work this spoon in navigable rivers, harbours, &c., it is necessary to have a flat built barge or lighter, from 30 to 50 tons burden, mounted with a small projecting crane work, made to throw out gear; and to within nine feet of this projecting crane, a rail should be placed to assist the spoon holder, and prevent him from falling over the barge. On the end of the barge where no crane is placed, a snatch block should be fixed, through which, and attached to the bottom of the bag, a small rope should be received.

The barge being thus mounted, and moored over the place where it is proposed to dredge, and one end of the working rope being fastened to the chain of the spoon, and the other end to the barrel of the crane, the man who is stationed at the handle or pole of the spoon immediately tumbles the spoon into the water. At the same moment the man at the crane work throws it out of gear, when the third man seizes the small rope, which is received through the snatchblock, and fast to the bottom of the bag, with which he runs along the gunwale, and prevents the spoon and bag from sinking until it gets near the other end of the barge, when the man at the pole turns it up, inclining the pole head towards the crane end of the barge, takes a turn with a small rope round the pole and rail, which keeps the spoon dredging along in its proper position, while the man at the crane, assisted by the other (who was employed at the snatchblock being now disengaged), draws along the spoon until it be nearly under the crane, when the man at the pole inclines it backwards, and the contents (now deposited in the bag) are hoisted up, and by their joint assistance emptied into the barge. A small tackle of pulleys may be suspended from a beam to empty the stuff into the barge. When the bag is discharged, they proceed as before, until the barge is loaded.

The bag and spoon dredge may also be successfully employed in dredging the foundations of bridges, &c., by erecting a platform to answer the purpose of a barge. The platform may be projected as the work advances, and the stuff taken up removed from the platform by a gangway and wheel barrows, where it cannot be otherwise disposed of.

In a commercial country like Britain, where ships have been gradually increasing in size, and more especially where harbours have little rise of tide, it is a matter of the greatest importance to construct dredging machines, which will increase the depth under low water of spring tides, in a more speedy and effectual manner than any we have yet described; and it is a fact well known, that all rivers, harbours, and canals, have a tendency, less or more, to fill up. Dredging machines should be like the tools of a perfect workman, never out of order.

Improved dredging machines on the principle of an endless chain, have been undergoing such improvements as experience has pointed out; and it may not be deviating from our general plan, to remark, that when these machines were first constructed, horses were employed as the moving power, and had a circle ap-
DREDGING.

Steam dredging engine.

The frame.

Plate CCXXXIX. Fig. 1.

Fig. 2.

The chain of buckets.

propriated to them on board of the barge, that carried the machinery; and it was usual to have the horses so taught, that by the ringing of a bell they would immediately stop. One of these was long employed on the river Humber at Hull, and one at Port Glasgow; and there have been two constructed on the principle of an endless chain at the port of Greenock, the moving power being communicated by men and crane-work. The barges for these two last are built very flat, and square at both ends, and have an aperture up the middle, through which the bucket frame works, and the stuff is discharged over the end. This scheme answers very well on a small scale, but would not be advisable for a large machine.

As the recent improvements on steam engines have rendered them of the greatest value, particularly in a country which abounds with coal, every other moving power for dredging machines is rapidly giving way to the steam engine. Several of these have been for years employed on the river Thames, one at Hull, one at Bristol, one at Sunderland, and one at Aberdeen; and we understand they are now constructing several for dredging the entrance from the sea, and from the locks or lakes to the locks on the Caledonian canal. In one of these, the bucket frame will project considerably before the barge on which it is mounted, and be capable of sloping up canal banks, or, in other words, to work away high ground, and make a passage for the barge to follow.

In order to give our readers a more distinct view of this important branch of hydraulic engineering, we shall particularly describe one of the most powerful and most improved machines now at work on the river Thames.

One of the most powerful of these machines is explained in Plate CCXXXIX, where Fig. 1. represents an elevation and partial section of the machine, to explain the steam engine and wheel work contained in the inside of the vessel. Fig. 2. is a horizontal plan of the same. The machine is erected in the hulk of an old sloop of 50 or 100 tons burden, the figure and parts of which are too clearly explained by the drawing to require any particular reference. There are two chains of buckets to this machine, one on each side of the vessel, though only one of them is shown in Fig. 1. at EE, the other being omitted to make room for the small Figures. The endless chains revolve over rollers situated at the two extremities of strong frames of timber, marked EE, which rise and fall on a centre at their upper ends, their weight being suspended by pulleys aa, which being lowered down, permit the buckets ff, attached to the chain ee, to reach the bottom.

AA are two beams projecting a short distance from the sides of the vessel at the stern, upon which the two triangular timber-frames BB are mounted, to sustain a strong timber C extended across the vessel; these, with their cross timbers JJ, form a frame which supports all the machinery that is above deck. The beam C is as long as the whole width of the machine, and upon each end it has a cast iron bracket DD hanging downwards, as seen at D. These brackets support the upper end of the bucket frames EE, and also the centres for the chain barrels, over which the endless chains revolve by the motion of the machine. The bucket frames EE are each composed of four long timbers, bolted together, and braced by diagonal stays dd, forming a truss frame, which has sufficient strength to prevent flexure from its own weight. The pulleys aa suspending the lower end of the chain frames, hang from the beam FF, which extends across the vessel, supported on the top of two or three vertical posts erected on the deck. The upper end of each of the chain frames EE, has two stout iron semicircles bb bolted to the timbers, and terminating in rings or eyes fitted over two tubes or hollow iron centre pins, one supported by the bracket D, and the other by the frame B. On these pins the frame hangs as upon a centre at c, and can be raised or lowered as before mentioned. The upper roller for the endless chain, which is a square barrel, revolves upon the same centre of motion as the frame at c, and a similar square barrel of the same dimensions is placed in bearings at the lower end of the bucket frames, as seen at H in Fig. 1.; then the double endless chain e e e passes round both these barrels, and every other link of these two chains carries one of the buckets ff, which are made of wrought iron, as shewn on a larger scale at Fig. 3. They are pierced full of holes, to allow the water to drain out of the gravel as they come up: their mouths are of a semicircular figure, which renders them less liable to stick fast in the ground than if they were square. e. e. Fig. 1. represents a number of cast iron rollers placed on the inside of the beams of the chain frame, to support the weight of the chains and buckets as they pass up; for being very heavy when they are full, a great friction would otherwise be occasioned by the buckets dragging on the timbers.

The upper chain barrels for the frames on both sides of the vessel are in a line with each other, and both receive their motion from the steam engine, which is situated in the hold of the ship. Its parts are as follows: x, Fig. 2. is the boiler set in brick work, with the fire place beneath it; and a wrought iron tube Y, carried up to a high position, serves for the chimney, and is firmly braced by iron chains in different directions; z, Fig. 2. is the steam pipe communicating from the boiler to the engine, which is on Watt and Boulton's principle; P is its working or steam cylinder; Q the working beam or great lever, which is made of cast iron; its centre being supported on the top of four iron columns III, which stand upon the floor of the engine S. The connecting rod T of the engine is jointed to the extremity of the beam Q at the top, and the other end to the center of the shaft O. For a more minute description of the engine, which acts in the same manner as any other made by Watt and Boulton, see Steam Engine.

The fly-wheel V of the engine is turned by the large spur-wheel W, fixed upon the shaft O, acting in a pinion on the axis of the fly-wheel, to give it a greater velocity than the crank, by which means a smaller fly-wheel is made sufficient to regulate the motion of the engine.

The motion is conveyed from the engine to the chain wheels by an inclined shaft L, seen more plainly in the plan. At the lower end it has a bevelled wheel M, receiving motion from the wheel N, fixed on the main shaft of the engine. At the upper end of the same inclined shaft is a bevelled wheel K. Fig. 2. working another, J, fixed upon a shaft, situated in a line with the centre of the two chain barrels. At the two extremities of this shaft, two circular iron plates, or wheels, are fixed at ii; these are received into boxes, or hollow wheels, which are fixed on the extreme ends of two other shafts, placed in a line with the former, and leading to the chain barrels. These boxes and wheels form a connection between the several parts of the shaft; and by the friction of the wheels, which are accurately fitted into the boxes, a sufficient power is communicated to turn...
the chain barrels round, and bring up the gravel; but in case the buckets should take hold too deep in the ground, so as to endanger the breaking of the machine, these boxes will slip, and thereby prevent the chain from being broken. The construction of one of these boxes is explained more particularly in Fig. 4: it consists of a cast-iron wheel \( l \), wedged fast on the end of the shafts \( m n \), which is that in the middle of the ship carrying the wheel \( l \). The other wheel, or box \( k \), is cast hollow, as shewn in the section; and the first, \( l \), fits into it, being kept in its place by two ears \( o o \), screwed on by two bolts. These pressing hard against the rim of the wheel \( l \), causes a considerable friction, which will carry the shaft \( m \) round in its fair work, but if over-stretched, will slip. \( m n \), Fig. 2, are levers, which operate upon coupling boxes on the main horizontal shaft, and give the means of disuniting either of the chain barrels at pleasure, if one of them needs repair, whilst the other continues its work. The blocks of the pulleys \( a a \), which suspend the great bucket frames, are received with a chain, the fall of which passes through the snatch-block \( r \), fixed down upon the deck, and then winds round the roller \( s \). This is turned by the engine, the axis of it having a worm-wheel \( t \) fixed upon it, turned by the worm \( v \), which is seen endwise in the plan, and shewn on a larger scale at Fig. 5. This worm is in reality formed upon the inclined spindle \( l \), though it could not be shewn in the true place without making a confusion. Either of the bucket frames can, as before mentioned, be thrown out of gear, or stopped by clutch boxes, to the lever \( m m \), Fig. 2.; and then the lower end being hauled up by the pulleys \( a a \), till it hangs in a horizontal position, will be very accessible, to repair the chain, or any of the buckets, which frequently meet with injuries from obstacles at the bottom of the river.

The mode of action in this machine is evident from its structure: it is moored in the stream by the head or stern, or both, in some situations, if it is required to work across the stream. The engine being put in motion, the chain-frames are lowered down, by giving out the chains of the pulleys \( a a \), until the buckets drag sufficiently upon the bottom, to become filled with ballast in their passage, and come up along the top of the frames, by the motion of the chains, till they turn over the second, or chain-barrel, of the vessel, or for the sake of emptying the second barrel of the vessel. They then pass into large hoppers, or troughs, which are suspended by ropes from the beams \( B B \) and \( C C \); and being placed rather inclined, the troughs conduct the gravel into barges, which are moored beneath the extremity of them. Neither of these hoppers, or troughs, are shewn in the Plate, as they would tend to confuse the parts of the machine. The motion of each barrel is managed by a single man: he stands near the end of a long lever, which supports the pivots of the worm-wheel \( t \), so that, by moving the end of this lever, the wheel can be disengaged from the worm at pleasure, to give it motion, or set it at rest. There is also a gripes, or brake-wheel, not shewn in the Plate, fixed upon the spindle of the roller \( z z \); and the grip is so forcibly grasped upon it by a loaded lever, as to prevent the roller running back by the weight of the chain frames, even when the wheel \( t \) is disengaged from the worm. The wheel \( t \) is attached to its spindle only by the friction arising from its fitting on a circular part, so that it is at liberty to slip, if overstrained, without breaking the teeth; but it is provided with screws, as shewn in Fig. 5, which may be adjusted, to give sufficient friction to raise the load it is required to take up without slipping.

The attendant has the management of both the levers above-mentioned; and by means of them, he can cause the buckets to go just as deep as he wishes, to take up the proper quantity of ballast; and as they deepen the channel, he gradually cases the grip-lever, which permits the frame to descend lower down; but if at any time the buckets meet with an obstacle, or take such deep hold as to stick fast, (which they will do, without stopping the engine, because of the slipping box, Fig. 4,) he engages the wheel \( t \), with the worm, by means of the lever for this purpose, and this winds up the chain of the pulleys \( a a \), till the end of the frame is raised so high from the bottom as to disengage the buckets, which then resume their motion; and the wheel \( t \) is to be immediately cast off from the worm, because it is unnecessary to raise the frame any higher; but it may, if required, be lowered down to reach the bottom again, by relieving the brake-lever. In this manner, the operation proceeds with the greatest safety and dispatch. There are two other rollers similar to \( t \), situated just above the deck, and kept constantly in slow motion by the engine, for the purpose of advancing the engine along in the water. Thus, a strong rope is attached to a mooring block or anchor, placed at some distance up the stream, and is passed once or twice round the roller; then a labourer holds on the end of the rope, in the same manner as is done by a capstan; and thus the whole engine is slowly brought up, as the channel is dredged, and constantly advanced to operate upon a fresh part of the bottom.

The engine is of 16 horse power, and when dredging in a moderate depth, will bring up enough to load two barges, 35 tons each, in an hour, with only three or four men to attend the whole; and the engine will consume about 349 lbs. of Newcastle coals per hour.

Before concluding this article, we are desirous of recommending to those who intend to construct barges for carrying dredging machines, that no expense should be spared in having them built in the most substantial manner; for after the apparatus is erected, the smallest twisting of the barge may be the means of breaking parts of the machinery. Machines on the same general principle may be erected on any scale, and to dredge in any reasonable depth of water. This depends entirely on the length of the bucket frame \( m \), which will be that work best suited for barges of 45 ft. long. We may further remark, that when it is intended to dredge in shallow water, regard must be had to the construction of the barge, which should be broad and flat, and of a small draught of water, which will give more time to work, as they can only work whilst the barge is afloat. We may also notice, that machines on the foregoing principle work very well with a bucket frame on one side only, which is a considerable saving of expense. Upon the whole, these machines are capable of bringing up sand, mud, clay, or gravel; and even stones of considerable size may be taken up, as has been done at Aberdeen, without the smallest risk to the machine, when properly managed. (J. F. (W. G.)

Dresden, Dresden, Dresnem, Dazene, Dazonech, and Dresena and Dresda in Latin, is the capital of the kingdom of Saxony. It is situated in a rich and fertile country, on the banks of the river Elbe, at its junction with the Weseritz, and is divided into two parts, called the old and new town, by the first of these rivers. The town properly consists of three parts, Old Dresden, with its three suburbs; the new-town, (Neustadt,) which received this name from Augustus 11.; and the Freckenstadt or Ostra, which
is connected with the suburbs of Old Dresden by a stone bridge over the Weisseritz. The bridge which unites the old and new town, and which has been either destroyed or greatly injured by the French in 1813, was reckoned one of the finest in Europe. It was built of stone, and consisted of nineteen extremely flat arches; its length was about 707 ells, and on the fifth pier was placed an instrument for measuring the height of the river. Augustus II. furnished the bridge with footpaths, and adorned it with an iron balustrade, with vases, trophies, and lamps. The streets of this city are sixty-one in number, and are straight, spacious, well paved, and well lighted; and the houses are in general high, well built, and commodious. The town contains several handsome squares, and many elegant public edifices.

The royal palace, formerly the electoral palace, is a very fine building, and owes its chief ornaments to Augustus II. The floors are principally of exquisite marble, and the walls are covered with mirrors.

The green room, or vault, which contains eight rooms, is particularly splendid; and the hall of the giants, the hall of audience, and the chambers of parade, are worthy of peculiar notice. The tower of the palace is 355 feet high, exclusive of the conductor. The green room contains a prodigious number of natural and artificial curiosities.

The celebrated gallery of pictures occupies the second floor of the palace. It consists of several rooms communicating with one another in a circular form, and contains 1200 paintings, by 334 masters of the principal schools of painting. All of these are originals, and are admirably preserved. Besides many pieces of German, Flemish, and Dutch painters, the gallery contains the best works of Hannibal Caracci, Raphael, Guido, Albani, Leonardo da Vinci, Vandyck, Titian, Andrea del Sarto, Rembrandt, Carraraggio, Tintoretto, Nicolas Poussin, Luca Giordano, Corregio, Battori, and Rubens. The Night and the Magdalen of Corregio are greatly admired. A list of the principal pictures will be found in Naudiz's Travels, vol. ii. p. 309. In the year 1806 this gallery was enriched with a large historical painting by Fr. Mathew, with twelve figures, representing Egistheus punished by Orestes and Pylares in the palace of Agamemnon.

The palace of Prince Antoine is situated in the Faubourg, and that of Maximillian, which is a small though a light and elegant building, is situated on the other side of the bridge.

The Japanese palace, or the Dutch palace as it is often called, stands in a most picturesque situation, elevating its majestic domes among the boughs of trees. It is a large square building, and was intended by Augustus III. for a Chinese palace. The garden is small, and at the end of it near the water is a terrace, which commands a delightful view of the city, the river, and the environs of the town. The ground floor of this palace is devoted to the collection of antiques, which fills a long suite of rooms. It was formed between 1720, and 1739, by Augustus III., who purchased the greater part of the gallery of Prince Chigi, at Rome. He paid 6000 ducats for the vases of porcelain made at Rome, and painted by Raphael, and he also bought from the elector of Brandenburg two porcelain vases from Japan. The collection of porcelain is reckoned the finest in Europe, and consists of several millions of pieces of all kinds, from every country, and of every age. Mr Lemaistre, who has given an account of several of the arti-
cles in this cabinet, considers it as the finest which he has seen, excepting the collection of antiquities at Paris. The three Grecian statues of females, which were found in the first excavations made at Herculaneum, in 1760, are particularly admired.

The two upper floors of this palace are appropriated to the public library, which contains above 150,000 volumes, and 2000 manuscripts. The books are kept in high order, and the library is open several days in the week to the public, who are even allowed to carry the books to their own houses.

The Tresor, or the collection of jewels, contains a vast assemblage of diamonds, and other precious stones, and innumerable curiosities in ivory, enamel, coral, and Jasper, with clocks and other mechanical instruments.

The gardens called Der Zwinger, which form a kind of public promenade, contain several unfinished buildings, which were intended by Augustus II. to form part of a magnificent palace. The architecture is loadd with ornaments, and many of the buildings are in a state of ruin. These buildings contain a cabinet of prints and designs, which is deemed one of the finest in Europe, and contains specimens of the art from its infancy to its present state; a cabinet of petrifications and incrustations, and other objects of natural history; a cabinet of anatomical preparations; and a saloon of mathematical and physical instruments. The other public buildings, are the large and the small opera house, the assembly-rooms, the arsenal, which contains the first fire arms invented by Bertholde Schwarze, the military academy, the carousel, the barracks, the mint, the landing or state house, the royal China warehouse, the hotels of Schoenberg, Saul, of the Countess of Mokenska, of Flemming, of Anholt, of Vitzthum, of Bruhl, of Cosel, and of Marcolini, the last of which is remarkable for its furniture, its pictures, and its gardens, and for the colossal groupe of Neptune and his court. The hotel of Count Bruhl is now employed as a depot for the porcelain manufactures; but the garden is open to the public, and forms a delightful promenade on the banks of the Elbe. The carousel, or the court where tournaments and battles with wild beasts were formerly exhibited, appears to have been once a fine edifice, but it is falling rapidly to decay.

Dresden contains about 18 churches, the most remarkable of which are, the church of the Holy Cross, the church of the Catholics, the church of the Court, the church of Notre Dame. The church of the Holy Cross is an enormous circular mass of stone, and the painting at the great altar was executed by Schoenborn. The church of the Catholics, built by Augustus III. between 1737 and 1756, is one of the finest in Germany, and the handsomest building in Dresden. It stands delightedly on elevated ground, nearly fronting the bridge over the Elbe. Its organ is the chef-d'œuvre of the celebrated Silbermann. It is decorated by several admirable paintings by Meugs, a native of Dresden, among which is the Ascension, which is reckoned his chef-d'œuvre, and adorns the principal altar. The tower is 303 feet high, and the total expense of building it and the church was 906,955 rix-dollars. The church of Notre Dame, or St Mary's (Frauen Kirche,) was built in 1734 by Augustus II. on the plan of St Peter's at Rome. It cost 300,000 rix-dollars. From the lantern of the cupola the view is universally admired.

The literary and charitable establishments are numerous and well managed. The principal of these are the academy of painting and architecture, the annual exhibi-
DREUX, Dircasses, or Durcasses, is an ancient town of France, situated in a district of the same name, in the department of the Eure and Loire. It stands in a fertile valley on the river Blaise, at the foot of a mountain, and is supposed by some to have derived its name from the Druids. It is celebrated for the great battle which was fought in the neighbourhood in 1562, under Charles IX.; when the Protestants were routed, and the Prince of Condé taken. There are several manufactories for woollen and linen cloth, hats, and stockings, at Dreux, and some tanneries, besides a manufactory for cloth for the clothing of troops. Population 5437. (n)

DRILL HUSBAND. See AGRICULTURE, Index.

DRILL PLough. See Agriculture, Index.

DRIMIA, a genus of plants of the class Hexandrhi, and order Monogynia. See Botany, p. 183.

DROGHEDA, or Tredagh, as it was once called, is the name of a borough town in Ireland, situated between the counties of Louth and Meath, and possessing the privileges of a distinct county. It stands on both sides of the river Boyne, at the distance of about 5 miles from the Irish Sea. The town is large and well built, and is still surrounded with the greater part of the walls by which it was formerly defended. From the rapid ascent of the ground on both sides of the river, the houses stand on different levels, and show the town to great advantage. Although Drogheda is a bad harbour, yet it is a place of considerable trade. It lies opposite to Liverpool; and the river is navigable for ships of 150 tons burden up to the town, where there is a handsome and convenient quay for receiving them. Great quantities of corn are shipped here, and coals are imported to a great extent, and conveyed by the river into the interior, and by means of a canal as far as Navan. There is a licensed distillery in the town, and a well endowed school. A great deal of coarse linen and linen yarn is sold here, and the markets are plentifully supplied with provisions. The town is governed by a mayor, sheriffs, and a common-council. The corporation is large, and the body of freeholders numerous; but the borough is under no political influence.

The four mills of Slane are about seven miles distant from Drogheda, and they communicate with it by water carriage. Mr. Beaufort states the population of this town at 15,000, reckoning 6½ individuals to every house. During the rebellion, when the names of the inhabitants were affixed to the door-posts of every house, the average of individuals in each house was 8½ in the town, and 5½ in the suburbs. The inhabitants are principally Catholics; and are remarkably poor. See Beaufort's Memoir, &c. and Wakefield's Statistical and Political Account of Ireland, passim. (n)

DROITWICH. See Worcester.

DROME, is the name of one of the departments of the south of France, and derives its name from the river Drome, by which it is traversed. It was formed out of the Valentinois, the Diois, and the Trias. It is bounded on the north by the department of the Isère;
on the west by that of the Ardeche; on the south by the departments of Vaucluse and the Lower Alps; and on the east by the departments of the Higher Alps and the Isere. The principal rivers of the department are the Drome, which has its source in the Valdrome near Serres, and falls into the Rhone near Crest; the Isere, the Roubion, and the Jabrone, which passes by Montelimart. The principal lake is called the Lac de Luc; and it and all the rivers abound with excellent fish.

The principal productions of the department are corn, vines, fruits, olive-oil and nut-oil, wool, silk, and mineral waters. Owing to the mountainous nature of the country, and the dryness of its sandy soil, the corn which it grows is not sufficient for its consumption. Wine is produced in great quantities, particularly on the banks of the Rhone, and in the districts of Die and Nyons. The most celebrated are those of L'Hermitage, Brezème, Château-neuf-du-Rhône, and Donzière. The mulberry tree thrives well, and silk-worms are reared in vast numbers, their produce amounting annually to upwards of three millions of French livres. The best pastures are at Gresse, Valdrome, and Vercors.

The trade of the department consists chiefly in cattle, butter, cheese, woollen and linen cloths, hosiery, hats, stuffs, thread, paper, and gloves. The superficial extent of the department is 69,27 square kilometres, or 350 square leagues. The forests occupy 75 or 76 hectares, or 148,000 acres, most of which belong to individuals. The contributions in the year 1803 amounted to 1,840,992 francs. The following are the leading towns in the department, with their population.

<table>
<thead>
<tr>
<th>Town</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valence</td>
<td>7532</td>
</tr>
<tr>
<td>Montelimart</td>
<td>6380</td>
</tr>
<tr>
<td>Romans</td>
<td>6000</td>
</tr>
<tr>
<td>Crest</td>
<td>4500</td>
</tr>
<tr>
<td>Chabeuil</td>
<td>4000</td>
</tr>
<tr>
<td>Die</td>
<td>3968</td>
</tr>
<tr>
<td>Dieu-le-Fit</td>
<td>2800</td>
</tr>
<tr>
<td>St Jean-en-Royan</td>
<td>2800</td>
</tr>
<tr>
<td>Nyons</td>
<td>2724</td>
</tr>
</tbody>
</table>

Valence is the chief town of the department. Total population 231,183. See Herbin's Statistique de la France; and Chantreux's Science de l'Histoire et de la Geographie, &c. (≠)

DRO. See Ber.

Drontheim, or Nidrosia, is a large town of Norway, in the district of Strinden, and the capital of the province of Drontheim. It is situated on a small gulf on the south side of the river Nid, from which it received the name of Nidroos, or the outlet of the Nid, and is almost wholly surrounded by that river and the sea. The town, which, excepting four houses, is wholly built of wood, has two suburbs, viz. Bakkelandet and Ladegaard, in each of which there is a church. The principal street in Drontheim, called the Munkegade, is a noble street, which extends through the whole breadth of the town to the shores of the Fjord. The buildings on both sides have a very respectable and agreeable appearance, and are in general tastefully ornamented. The beautiful island of Munkholm, crowned with its castle, rises majestically above the bay; and the view is terminated by mountains covered with snow. The principal public buildings are the town-house, the cathedral, two churches, a public school, an infirmary, a poor-house, an orphan-house, a house of correction, and a seminary for missionaries. The town-house, or Stiftsamthaus, stands in the Munkegade, and is now the residence of the chief magistrate, and the public bodies of the district. It is a large palace, which overtops the other buildings, and is visible at a distance of more than two English miles. Its style of architecture is simple and noble, but being built of wood, its ornaments have been distorted by the influence of heat and moisture, the enemies of all timber edifices. The cathedral, dedicated to St Oluf, which stands at the end of the Munkegade, was formerly a magnificent building of marble; but it was burnt down in 1530, with the exception of the choir, which still forms part of the present cathedral. This cathedral is still the finest and the largest edifice in Norway, and its great and extensive ruins enable us to form some idea of its former grandeur. The whole of the people of the north formerly resorted to it as pilgrims, to seek for the pardon of their sins on the grave of St Oluf. The town is protected by the fort of Christiansen, built in 1680, and by the castle of Munkholm, which is situated on a rock in the harbour, and which was the prison of the Danish chancellor Greiffenstien, who died in 1699.

In 1783, a school was opened at Drontheim by individuals, assisted by government, for the purpose of instructing the youth of both sexes in useful knowledge, and in the living languages. The annual payment is 10 rixdals for a boy, and five for a girl. In the year 1790, a Society of Sciences was established at Drontheim. The plan was approved and sanctioned by the king in 1787. The meetings of this society are now held in a large and beautiful stone edifice erected within these few years, and the only building of the kind in the north of Norway. The first story is occupied by the society; the high school is kept in a room below this, and the teachers inhabit the second story. The society possesses the libraries of two celebrated historians, the rector Dass and Schoening. The collection is large and excellent, and there is also a great number of manuscripts connected with the topography of the country. Counsellor Hammer, a vain collector of curiosities, bequeathed to the society, about six years ago, the whole of his collection, and a considerable sum of money; but this valuable gift, was burdened with the condition of the money being first applied in publishing the useless manuscripts of the donor. The Memoirs, which are written in Danish, contain researches in natural history, physics, and rural economy; and since the year 1784 its Transactions have been regularly published.

The port of Drontheim is frequented only by small vessels, on account of the great number of rocks at the mouth of the harbour. About 400 or 500 ships are annually employed in its trade.

In the year 1768, the amount of the exports of Drontheim was 401,507 rixdals, and of the imports 254,999. In 1790, the value of export amounted to 750,000 rixdals. In 1799, there belonged to Drontheim 63 vessels above 10 lasts. In the year 1783, the number of vessels which arrived in the harbour was 250.

The principal articles of trade are timber for masts and other purposes; copper, to the amount of 200,000 cwt. from the celebrated copper works of Roraa; iron, goat skins, furs, salt fish, herring, tallow, train oil, hides, peas, and potatoes.

The iron works at Roraa afford sustenance to nearly one-fourth of the families in Drontheim, and keep the
whole valley between Drontheim and Rorans in constant activity. An immense number of horses is employed between the two places. In winter, the copper is brought down over the snow in long rows of sledges, which carry back provisions and other necessaries. It is a remarkable circumstance that the cows are prudently fed; the dung of horses. Sometimes it is boiled in large kettles, and when mixed with a little meal, it becomes a fattening mess for cows, pigs, sheep, geese, hens and ducks, and even horses.

There are only a few manufactories in Drontheim. M. Lysholin, the commander of the town, has established an infirmary for preparing colours from the Norwegian lichens, which are collected by a number of boors in Opdalen. This gentleman also possesses a manufacture of saltpetre, and another for obtaining white kitchen and table salt from impure sea salt. In the house of correction, cloth, linen and carpets are manufactured.

In the year 1780, 48 large silver pieces, some of which were round, some square, and some triangular, were found in Drontheim. In 1789, a copper trunk was discovered, containing several coins of Frederick III. In 1805, 32 silver coins of Eric of Pomerania were found; and at a still later period, ancient silver coins, and four or five urns of a rare metal, were discovered in a sand bank. Most of these pieces of antiquity have been deposited in the Muséum at Copenhagen. In the neighbourhood of Drontheim, there are many elegant country houses. Several are pleasantly situated along the shore of the bay, on the road to Houan, towards the Fiord, and on the slope of the hills. The population of Drontheim in 1769, was 5476, in 1799, 8000; and in 1806, 8340. The position of this town, according to astronomical observation, is in E. Long. 10° 25' 25", and N. Lat. 63° 25' 50'. See Catteau's Tableau des États Danois, passim; and Van Buch's Travels through Norway and Lapland, during the years 1806, 1807, and 1808, translated by John Black, chap. v. London, 1813. (x)

DROPSY. See Medicine Index.

DROSERA, a genus of plants of the class Pentandria, and order Pentagynia. See Botany, p. 169.

DROWNING, is the extinction of life, in consequence of immersion in a fluid. It is now well known, that no animal can live without a communication with atmospheric air. Even fishes require a supply of it; for if the vessel of water in which they are kept be closely stopped, death immediately ensues. It has been likewise ascertained, that atmospheric air serves the same purposes in all animals; or, in other words, undergoes the same changes, in order to fit it for their use. These changes are effected by means of respiratory organs, with which every animal is in one shape or other furnished. Atmospheric air consists of three substances, azote or nitrogen, oxygen, and carbonic acid.

Animals accustomed to live in air perish very soon, when their respiratory organs are immersed in water; whilst the more perfect or complicated these respiratory organs are, the shorter is their duration in general, and the sooner is extinguished by such immersion. Man is capable of existing without breathing only for a very little time; and hence is soon destroyed when detained beneath the surface of the water. Most people begin to drown before they have been half a minute below it. But it is certain, that those accustomed to dive can continue a great deal longer in this state. Pearl fishers are affirmed to remain with impunity several minutes beneath the water. It is said, that some of those about Cape Comorin, in the East Indies, will keep below the surface for fifteen minutes, or even double that time. But this is probably an exaggeration.

It is still unknown to us on what the principle of life actually depends; and hence we find it often apparently lost, without its being really so. This has been denominated suspended animation, or apparent death. The term suspended animation, however, has been objected to by Dr Goodwyn, as conveying a false notion, leading mankind to believe that they are capable of re-animating, or reviscuscating, a lifeless mass, when in fact they do not more than cure a disease. "Of animal bodies," says he, "there are only two general conditions—life and death; and since by death we understand the privation of life, there can be no intermediate state between them. Of the body, in this disease, (he means apparent drowning,) we can say with propriety only, that it is alive, or that it is dead. If it were really dead, it would necessarily follow that the means which are employed to recover it must be supposed to communicate life to dead matter, which is impossible. The body therefore is alive, but with a degree of life less perfect than in the ordinary state of health; and since a difference in degree does not occasion an alteration in kind, the body must still retain that principle which is the immediate cause of all the functions that are performed in health, only it is not now excited to action; because the external concomitant circumstances which operated upon it in health are removed. These external circumstances are heat and respiration."

A certain test of death has long been, and still is, a Test of desideratum in medical science. All are now agreed death. The most complete cessation of every vital, natural, and animal function, is no sure proof that the person is absolutely dead. But it has been commonly thought that putrefaction is a certain test of this state. Mr Kite, however, has gone far to show, that even this may be fallacious. A sure indication of death, he thinks, can be drawn from the contraction of the pupils of the eyes; from one of these being more contracted than the other; from a total loss of heat, and, in the case of drowned persons, from the presence of water in the lungs. It is his opinion, that in drowning, the epiglottis completely shuts the passage to the lungs, till relaxation has taken place after absolute death. No appearance of water in the lungs was ever shown by any of the successful cases of the Humane Society, and Mr Kite immersed a kitten in a strong decoction of logwood, under a glass receiver, and kept it there for 15 or 20 minutes after all motion had ceased. He then removed it into clear water, and let it remain for a considerable time. On opening it, the lungs were filled with water, but there was no appearance of the colouring matter; a proof, he says, that the water did not enter the windpipe for at least 15 minutes after apparent death had taken place. The entire loss of irritability, or of the power of contracting in the muscular fibre, on the application of the proper stimuli, seems to constitute the true distinction between real and apparent death.

It seems to depend a good deal on circumstances that have not been accurately ascertained, how long animation may be suspended without being irrecoverably lost; or how long a person may remain in the state of apparent death, and yet recover. Instances are on record of some that have continued apparently dead for hours, nay for days, and have yet been restored to life; but no instance, well authenticated, we believe, can be produced of any person having recovered who had been
DROWNING.

more than three quarters of an hour under the surface of the water. Indeed very few have been saved who had remained nearly so long in this state. The Reports of the Humane Society abundantly prove this. Three quarters of an hour is the longest space mentioned in which any person they have been so fortunate as to recover was ascertained to have been in the water.

The phenomena of drowning have been accounted for in different ways, and it is certainly of much consequence that we should be able to discover the true theory of it; for on this will evidently depend our knowledge of the means most proper to be used for the recovery of the apparently drowned. If we knew what change it is that, on being submersed, takes place, and extinguishes altogether, or suspends the functions of life, we should have no more to do than to counteract, as far as in our power, the effects of this change; and if we could counteract them completely, we should then recover the patient.

De Haen.

De Haen, who wrote on this subject, ascribes the death of drowned persons to the repletion of the lungs with water, by which, he says, the arteries of them are compressed, and the circulation of the blood stopped. This was, no doubt, a natural enough notion for a man to form a priori. But it unfortunately happens, in most subjects of this sort, that the most obvious or likely cause, or that which generally first occurs to the mind of a philosopher, is not the true one. Subsequent experiments and observations have shewn, that scarcely any water enters the lungs in drowning.

Cullen.

Dr Cullen, in his "Letter to Lord Catoheart," attributes the death of drowned persons to the loss of animal heat, in consequence of the stoppage of respiration; and says, that dissection shews, that no water in sufficient quantity to hurt the system enters the lungs, or even the stomach; and no injury is done to the organization of those parts.

Mr John Hunter, in the 66th volume of the Philosophical Transactions, conceives, that the loss of respiration has an immediate effect in stopping the other vital functions, particularly the motion of the heart: and that if a sufficiency of life still remain, nothing more is wanting than to restore the function of respiration, for then the heart will act, and all other parts depending so immediately upon it, will instantly move along with it. He attempts to confirm this, by observing, that when a new born child has been allowed to spend too much time after the cessation of those functions peculiar to the foetus, and before the new function of breathing has commenced, the disposition to the new mode of life is thereby lost, and the child would certainly die if respiration were not artificially induced, by the introduction of air into the lungs. He also adapted a pair of double bellows to the trachea of a dog, and thereby induced artificial breathing, which he could stop or set going at pleasure. He found, that on stopping the breathing, the heart stopped, and on recommencing the breathing, the heart again moved. This process was repeated, he says, ten times on the same dog, and always with the same result. The intervals betwixt the trials being five, eight, or ten minutes.

Fothesgill.

Dr Fothergill supposes, that drowned animals are killed by the stoppage of respiration, and the consequent stagnation of a quantity of foul air in the lungs, which soon thereby acquires a sedative and deleterious power. This stagnant air, he thinks, destroys by degrees the remnant of irritability, and thus, though hitherto unnoticed, probably gives the coup de grace.

Mr Kite, in his Essay on the Recovery of the apparent

by Death, attributes the immediate cause of death in drowned persons to an apoplectic state of the brain; for by the stoppage of respiration, the blood is prevented from readily circulating through the lungs, and hence must accumulate in the venous system. But according to Dr Munro, four times as much blood passes through the brain as through any other part of the body—equally extensive. Hence there is an accumulation in the brain more than in any other part.

Dr Goodwyn, however, in his treatise, On the Connection of Life with Respiration, has rendered it very probable that no apoplectic state of the brain is induced by drowning; but that the immediate cause of death, in such cases, is the want of a proper stimulus to the heart and arteries.

The blood, we know, is the stimulus which sets these organs in motion. But blood is of two kinds, systemic and pulmonic. The former of a florid red colour, the latter dark and gruminous. The florid red colour is acquired by passing through the lungs in respiration; but when this function is stopped, the lungs can no longer impart the above quality to the blood. The heart, as every one knows, consists of two divisions, a right and a left; and these contain each an auricle and a ventricle. Now, the dark-coloured blood seems to be the proper stimulus to the right side of the heart and its vessels, and the florid blood to the left. But when the blood ceases to be rendered florid by its passage through the lungs during respiration, the left division of the heart is deprived of its proper stimulus. It will consequently stop. But when the heart stops its action, the blood is no longer sent to the brain; and its excitement being withdrawn, death, or apparent death, will ensue. In attempting, therefore, to recover any person from apparent death, our object must be to restore the motion of the heart. But this is to be accomplished by restoring respiration, as thus the proper stimulus for the left side of the heart will be prepared.

We find, moreover, that a certain degree of heat is necessary to every function of life. Consequently the heat lost by immersion in cold water, or by any other accident which produces apparent death, must be gradually attempted to be restored along with the function of respiration.

To determine the changes that take place in living animals while immersed in water, Dr Goodwyn drowned, in a large transparent bell glass, several cats, dogs, rabbits, and other smaller animals; and he describes the phenomena of drowning in the following words: "When an animal is immersed in water, its pulse becomes weak and frequent; he feels an anxiety about his breast, and struggles to relieve it. In these struggles he rises to the surface of the water, and throws out a quantity of air from his lungs. After this his anxiety increases; his pulse becomes weaker; the struggles are renewed with more violence; he rises toward the surface again; throws out more air from his lungs, and makes several efforts to inspire; and in some of these efforts, a quantity of water commonly passes into his mouth: His skin then becomes blue, particularly about the face and lips; his pulse gradually ceases; the sphincters are relaxed; he falls down without sensation, and without motion."

On dissecting drowned animals immediately after death, Dr Goodwyn observed the following appearances.

1. The external surface of the brain was darker than usual; but there was no turidity of the vessels, nor any extravasation.
2. The cavity of the lungs contained a considerable quantity of a frothy fluid, and the
DROWNING.

Pulmonary arteries and veins were entirely filled with black blood. 3. The right auricle and ventricle of the heart he found still contracting and dilating; but the left ventricle was at rest, though the auricle and sinus venous belonging to it still moved feebly. 4. The right auricle and ventricle were filled with black blood, as were also the left auricle and sinus; but the left ventricle was only about half full of the same sort of blood; and the trunks and smaller branches of the arteries proceeding from it, contained some of this black blood also.

Dr. Goodwyn's next object was to determine whether the phenomena above described are to be attributed to the effect of water entering the lungs, or only to the exclusion of atmospheric air. He drowned several animals among ink, and afterwards some in quicksilver, and in all cases found that only a very small quantity of the fluid had entered the lungs. Of four cats and four rabbits which he killed by immersion in quicksilver, five drams of the fluid was the greatest quantity he could detect in the lungs of any one of them. In some of them, none of the quicksilver had entered the lungs at all. The five drams were found in the lungs of a cat. Could this be the cause of her death? Dr. Goodwyn, to ascertain the point, fixed another cat in an erect posture. He made a small opening in the trachea, by cutting out one of the cartilaginous rings, and introduced through this opening two ounces of water into the lungs. The only symptoms were a weak pulse, and difficulty of breathing; but these soon abated, and the animal lived several hours afterwards, with no apparent inconvenience. On strangling it, two ounces and a half of water were found in the lungs. This experiment was repeated on two other cats, and the only difference in the result was, that the difficult breathing and weak pulse were somewhat more conspicuous; but in a few hours the symptoms abated, and on strangling the animals, four ounces of water were found in the lungs.

From all these experiments it is inferred, that a small quantity of water only passes into the lungs on drowning; and that this, mixing with the pulmonary mucus, causes the frothy appearance mentioned by authors; that the whole of the fluid found in the lungs is insufficient to account for the phenomena of drowning directly; and that these are produced indirectly by the exclusion of atmospheric air.

With Dr. Goodwyn we agree in considering the effect produced on the human system by immersion in water as a disease; and have no objection to the name which he has given it, viz. Melanæma. His definition is perhaps as unexceptionable as most that could be proposed. Impedita sanguinis venosi in arteriosum conversione, cæbus signis, syncope et livor cutis. Would it not, however, be better expressed thus? Syncope, et livorum cutis, ab impedita sanguinis venosi in arteriosum conversione. The usual name is Asphyxia.

Let us now proceed to state the most efficacious and approved remedies in this disease. And here it can hardly be necessary to observe, that unless the exciting cause, viz. submersion, be removed in a very short space of time, all hopes of a cure will be evidently vain. Death will have ensued.

The cure of melanæma from submersion, or the disease occasioned by remaining under water, has, since the year 1767, attracted particular attention. The numerous accidents by water which occurred in Holland, from the great abundance of water conveyance in that country, occasioned in the above year the institution of a society at Amsterdam for the recovery of drowned persons. Plans of treatment were published, and premiums offered to all who should save, or even attempt to save, a citizen from perishing by water. In the course of a few years, it was found that this society had succeeded in recovering from apparent death 150 persons. The humane example of the Dutch was soon followed by other nations.

In 1768, the magistrates of Milan and Venice issued Italy orders for the treatment of apparently drowned persons. And in the same year, a short time after, the magistrates of Hamburg extended similar assistance, not only to the drowned, but also to the strangled, the suffocated by noxious fumes, and the frozen. The Empress of Russia caused the Dutch directions to be translated into Russian; and an edict was published in Germany in 1769, by which directions and encouragement were given to attempt the recovery of all who might be in a state resembling death, provided there seemed to be a possibility of affording relief.

The magistrates of Paris adopted similar measures in 1771; and in 1773, Dr Cogan and Dr Hawes of London proposed a plan for an institution to promote the recovery of apparently drowned persons in these kingdoms. In consequence of this, the Humane Society of London was formed in 1774.

The object of this society is to publish as extensively as possible, the best methods for promoting the recovery of persons apparently dead; and at the same time to offer premiums to such as apply these methods to practice. They undertake to distribute two guineas among the first persons, not exceeding four in number, who attempt to recover any person taken out of the water for dead, within thirty miles of London, provided the person so taken out has not been more than two hours under the water, and provided the assistants persevere in using the means recommended for two hours, even though unsuccessful; but if successful, they give four guineas. This reward is to include also any other instance of sudden death, such as suffocation by noxious vapours, hanging, syncope, freezing, &c. They give any publican or other person who readily admits the body into his house, and furnishes the proper accommodations, one guinea, and secure them from the expense of burial in unsuccessful cases. And they give an honorary medal to such as furnish assistance gratis. This medal has on one side a boy in the act of blowing an extinguished torch, with the legend, Letat scintillâta forsan: and on the other, a civic wreath, with the following inscription around it: Hoc pretium civi servato tuli. A blank within the wreath is left for the person's name who may obtain the medal.

As the directions for treatment published by this society are very generally known, we do not think it necessary to insert them here at full length. But as by far the most important of them, in our opinion, are those which relate to the restoration of heat and respiration, we must beg leave to copy them.

"When the body is taken out of the water, the clothes are immediately to be stripped off, if not naked at the time of the accident. It must then be covered with two or three coats, or a blanket, or any thing answering the purpose, that can be most easily procured. The body is then to be carefully conveyed to the nearest house, with the head a little raised. In cold and damp weather, it should be laid on a bed in a room that is moderately heated, or in summer on a bed exposed to the rays of the sun, with the windows open, and not more than six persons admitted. A greater number may retard the return of life. The body is to be well dried..."
with warm cloths, and gently rubbed with flannels, sprinkled with rum, brandy, gin, or mustard. Fomentations of any of these spirits may be applied to the pit of the stomach with advantage. A warming-pan, covered with flannel, should be lightly moved up and down the back; bladders and bottles filled with hot water, heated bricks or tiles, wrapped up in flannel, should be applied to the soles of the feet, palms of the hands, and other parts of the body.

Respiration will be greatly promoted, by closing the mouth and one side, while, with the pipe of a bellows, you blow into the other with sufficient force to inflate the lungs. Another person should then press the chest gently with his hands, so as to expel the air. Thus, the natural breathing will be imitated. If the pipe be too large for the nostril, the air may be blown in at the mouth. Blowing the breath can only be recommended when bellows cannot be procured."

The Society recommends also placing the body, when wiped perfectly dry, between two healthy persons in a bed; shaking it by the legs or arms for five or six minutes at a time, several times during the first hour; covering it with warm grain, ashes, lees, &c. and the warm bath, when any of these can be procured. They likewise recommend electricity, friction, and inflating the bowels with tobacco smoke. If sighing, gasping, convulsions, or any other signs of returning life appear, they advise a tea-spoonful or two of warm water to be put into the mouth; and if the power of swallowing be returned, to give a little warm wine, or brandy and water. The person, they say, should then be put into a warm bed, if disposed to sleep, as is generally the case, should not be disturbed, and he will awake, after a short time, almost perfectly recovered.

Bleeding. Bleeding they dissuade from being ever employed in such cases, "unless by the direction of one of the medical assistants, or some other respectable gentleman of the faculty, who has paid attention to the subject of suspended animation."

We would observe here, that the injecting of tobacco smoke, electricity, and bleeding, though generally had recourse to, are all very doubtful remedies. The first and last, from their sedative powers, are much more likely to depress, than to excite the vital principle; and we have not seen nor heard of any instance well authenticated, in which electricity, or even Galvanism, has been of undoubted advantage. Indeed, we suspect that, from their over-excitement, they rather do harm than good. The grand point is, to preserve the body in as natural and easy a position as possible—to bring it by the most ready means in our power gradually and uniformly to the natural degree of heat, viz. 98°, but not above 100°; and then inflate the lungs with fresh air. These are the indispensable objects which all others are only of secondary importance; but in desperate cases, every possible remedy ought to be tried.

One thing must never be forgotten, that vigour and perseverance are of the utmost consequence in attempting the cure of this disease. No patient should be left as dead, till the remedies have been applied for three or four hours. "It is a vulgar and dangerous opinion, say the Humane Society, to suppose that persons are irrecoverable, because life does not soon make its appearance; an opinion that has consigned an immense number of the seemingly dead to the grave, who might have been restored to life by resolution and perseverance." See Goodwyn on the Connection of Life with Respiration; Kite on the Recovery of the apparently Dead; Cullen's Letter to Lord Cathcart; Hunter, Phil. Trans. vol. lxxvi.; Ellis on Respiration; and Reports of the Humane Society. (*)

DRUG-GRINDING, is a very extensive trade in London, where several powerful mills are employed in levigating and preparing the drugs used by chemists, dyers, painters, and other artists, who, till within a few years, were compelled to prepare their own materials in small quantities and they consumed them. The largest and most complete mill is at the Apothecaries' Hall, belonging to the company of apothecaries. Great advantages are found in this change of system; for preparations being now made on a large scale, bave a much greater certainty of being of an equal quality. By employing powerful machinery, the expense of labour is greatly reduced; and the loss, or waste, in different processes, bears no proportion to that which is incurred by preparations of small quantities. In levigating drugs which are of a poisonous quality, the advantages of machinery are obvious, as the machines will act without the necessity of constant attendance, and may therefore be enclosed in a close room, where the people never enter, except to supply the machine with materials, or remove what it has completed; and at these times the motion is stopped, to avoid the danger of particles being thrown up in the air.

In Plate CCXL are drawings of most of the different machines which are used in drug-grinding. It CCXL. is needless to explain the connecting wheels which put them in motion, because they are similar to other mills which are driven by the power of steam engines; though some drug-mills in the country are worked by water wheels.

Fig. 3. is a pounding machine, or mortar, to be used for coarsely breaking such materials as are too hard, and in too large masses to be reduced by other means than a heavy and sudden blow. AA is a mass of cast iron, in which are four cavitv, to form as many mortars for the reception of the drugs. The pestles BBBBB are likewise of cast iron, fixed at the lower end of wooden beams, or stampers. These are fitted to rise and fall between the cross rails aa and bb, which are fixed at the ends to the principal uprights EE, or frame of the machine. The stampers are lifted by cogs, projecting from an axis D, which is kept constantly revolving, by the power of the mill; and the cogs are arranged upon the shaft at intervals, so that they lift the stampers in succession, and by this means a constant action is kept up. As the pestles may not pulverize every particle to a fine powder, unless the operation is continued for a great length of time, this machine is only used to break the drugs coarsely, and prepare them for other machines.

A pair of rolling or edge stones are shown in Fig. 1: Rolling two of these marked AB, called the runner stones, are stones, placed edgewise upon a horizontal stone DD, called the bed. This is firmly supported upon masonry, to sustain the pressure of the other two travelling or rolling over its surface. This they are caused to do by being united to a vertical shaft E, which receives the spindle or axle of the stones AB through it in a mortise, as shown by the dotted lines. The shaft receives a rotatory motion, by means of the cog wheel F, and thus compels the runner to revolve with it; their weight being borne by the bed stone D, they crush and pulverize the materials which are spread upon it. The mortise, which admits the axle of the runner stones through the shaft,
is made pretty long, to permit the stones to rise up, when there is a considerable thickness of matter beneath them, without raising the shaft. The stones ought to grind the drugs to powder, independently of merely rolling over it, by a sort of rubbing motion which they have upon the bed. This is produced by the stones AB being cylinders of considerable breadth, and revolving round on a small circle upon the bed stone: Hence the edge of the stone which is nearest to the centre of the shaft does not describe so large a circle, or pass through so great a space as the outside edge, which is more distant from the centre; but all parts of the breadth of the runner move with the same velocity round its own axis, some parts must of course have a sort of grinding motion upon the bed stone, the outer parts of the edge of the runner moving upon the bed slower than it would move by mere contact with its surface, and the inner parts of the edge moving slower. This circumstance very materially aids the operation of the grinding, and by constantly disturbing the materials, it prevents them from consolidating into a cake. The rolling stones will levigate to an almost impalpable powder, if their action is continued long enough, and will reduce almost any substance, if the weight of the runners is proportioned to the hardness of the material they are to grind. All drug mills have several sets of these stones, of different sizes; and a great advantage in the use of them is, that they are very readily cleaned from all remains of any drug. When it is required to grind a different sort, it is done by first sweeping them clean, and then grinding them for a few minutes on dry bran, or saw-dust, which takes up every particle from the stones.

Fig. 6. is another kind of rolling stone, invented by Mr Eckhardt. In this the runner A is almost of the shape of a bottle, and is placed upon an inclined axis B, supported in a frame DEF, which revolves upon two pivots, one at A, in the centre of the bed-stone H, and the other at E, sustained by the framing of the null. To the upper part of the revolving-frame, the large cog-wheel FF is fixed, to turn the machine round. The bed stone H is hollowed, as shewn in the Figure, to adapt it to the action of the runner. This machine is well adapted for reducing drugs to an impalpable powder, by a long continued motion. The runner should then be light, that it may take less power to work it.

Fig. 4. represents a different method of levigating. AB is a cast-iron pot, shaped like a cone, with a hemispherical bottom. In this is placed an iron grind D, which is rather conical, and has a spherical end, to fit the bottom of AB. At the upper end of D, a heavy weight E is fixed. The materials to be ground are thrown into the vessel AB, in small quantities: then the grinder being caused to revolve round in the pot, rolls successively on the whole surface of the cone, and grinds upon the drugs within it, a sufficient pressure being occasioned by its own weight, aided by the mass of E. The motion is communicated by a vertical spindle F, supported in framing G, so as to be exactly in the axis of the cone AB. It is kept in constant motion by a pivot, working in the great wheel H of the mill: On the lower end of the spindle, an arm S is fixed, and has at its extremities an eye to receive the end of the grinder; therefore, when as the spindle turns, it moves the grinder round in its pot; but that it may be allowed to accommodate itself to the quantity of matter which it rolls over, the eye of S does not fix the end of the grinder, but a collar a is fitted upon a pivot, formed at the upper end thereof; and this is connected by two links, like a chain to the sides of the eye, as shewn in Fig. 5. This machine will very effectually reduce drugs to an impalpable powder, because the powder is kept in constant agitation; and therefore, every time the grinder rolls over it, the surfaces are ground, and no particle can escape. This agitation is occasioned by the lower end of the grinder underming the powder, which has been caked up against the other side of the cone, by the grinder rolling over it, and by breaking the cake it causes to fall down, as shewn in the Figure. The pot is surrounded by a table I, to prevent anything being lost; and this may be extended to any size, to contain several machines, which, being arranged in a circle, will all be actuated by the same large cog-wheel H. The fine sorts of snuff are ground in machines on this principle.

Fig. 2. is a machine used by Mr Rawlinson of Derby, to grind indigo, or other drugs, in a dry state. A, is a mortar, formed of marble, and nearly hemispherical within. The muller or grinder B, is likewise of marble, and revolves within the other, being turned by means of a crank D, formed on the spindle, which is supported vertically in the frame E. The muller is shaped something like a pear, and has in the lower part a leaf, or notch, which is of great use in keeping the materials in constant motion, whilst they are ground between the surfaces of the muller and that of the mortar. The pressure is regulated at pleasure, by the addition of weights F, on the upper end of the spindle, in addition to the weight of the muller.

Fig. 8. is a method of grinding, which is equally applicable for reducing dry powders, or for preparing them in a semi-fluid state, as colours and some drugs are prepared; for to the great object is to produce a thorough incorporation of the ingredients with the fluid. AA is a circular iron vessel, the bottom of which is adapted to receive three or four large cannon shot BB. These are made to roll round within it, by the action of arms a, which project from a vertical axis D; for as this revolves, its arms push the cannon balls round in the vessel A, and they roll over the drugs. For dry grinding, the ends of the arms are made long enough to reach down to the bottom of the vessel, and thus rake up the powder immediately after the ball has passed; a circumstance which is essential for making impalpable powders, because, when the substances are ground to a certain degree of fineness, the pressure will otherwise consolidate the powder into a cake, and prevent its further reduction. The axis D may be put in motion by wheel-work from the mill, or by a bevelled wheel d, working in the teeth of a pinion e, which is situated upon the horizontal axis f. This has a handle upon one end of it, by means of which a boy turns it; and at the other end is a fly wheel, to regulate the motion. The framing is too evident to require any explanation.

Fig. 7. is another machine, acting with cannon balls: it consists of an iron vessel AA, of a circular figure, having its interior surface cast with three semicircular channels, running all round it, for the reception of the shot BBB. The vessel is mounted upon an axis D, which is supported in framing EE, and by means of a large cog wheel F, the whole is turned round with the same motion as barrel churn. This causes the balls to roll within it, just as the balls and the powder will always occupy the bottom part, the powder is reduced as fine as possible, by the balls passing over it. The powder constantly falls down from the upper part of the vessel to the lower, and thus every part of the mass is subjected to the action of the balls. A great
D R U I D S.  

Druids were the priests of the ancient Britons, and other Celtic tribes. Respecting them, and their religion, antiquarians have indulged in many opinions, and advanced many circumstances as facts, which are totally unsupported by any authority or evidence. In this article, therefore, our principal motive and object will be to explode what is fictitious and unfounded, to correct what is erroneous, and to reduce our real and well-authenticated knowledge respecting the Druids and Druidism, to those narrow limits which truth imperiously assigns them. In the execution of this plan, we are well aware of the difficulties which lie in our way, from the intermixture and confusion of conjecture and imagination with authority and evidence, and of the violent and long-established prejudices which we must encounter and overcome.

According to most of the numerous writers who have treated on this subject, Druidism was established over many of the countries of Europe; and the Druids had anticipated the discoveries of Pythagoras, Epicurus, Archimedes, and Newton: their supposed discoveries they had made, in barbarous countries, during the darkest ages of superstition and ignorance, and while they themselves were cut off, both by their situation, and by their peculiar mode of life, from every thing that was civilized and enlightened. Our object is to prove, that the Druids were confined to very narrow limits; and that, so far from deserving the high and enthusiastic praises bestowed upon them for their learning, they were ignorant and extremely barbarous in their manners, and gloomy and cruel in their superstitions. In doing this, we shall consider the etymological derivation and meaning of the term Druid; the origin of their order and worship; the countries in which they were actually found; the ranks and orders into which they were divided; the powers, immunities, and privileges which they enjoyed; the tenets and religious opinions which they held; the deities whom they worshipped; the superstitions to which they were addicted; their modes and places of worship; the knowledge and learning which they actually possessed; and the period and causes of their extinction.

The authors of the Ancient Universal History have very justly remarked, that respecting the Druids we have only a few imperfect and incidental notices in Cesar, Diodorus Siculus, Strabo, Meli, Lucan, Tacitus, Pliny, and Ammianus Marcellinus. "These have written in so loose a manner (continue the same authors) that all their fragments put together would hardly amount to three or four pages, and these reduced to their just value, would lose one half of their bulk; whether it be that these authors but just copied one another, or only designed to say the same thing." From this statement, virtually acknowledged to be correct by one of the warmest admirers of Druidism, Colonel Vallancey, who confesses that the tenets of the Celtic religion are not as yet fully known, we may easily perceive how very limited and imperfect our real knowledge of the Druids must be, and how greatly those writers who have expatiated on the subject with so much fulness and minuteness, must have been indebted to their imagination. From the ancient authors just named, however, we must draw most, if not all, of the facts on which we can depend respecting Druidism; for the testimony of Celtic writers, whether Welsh or Irish, can never be admitted, till they are proved to have lived near the time when Druidism flourished; and even granting that they did live near this period, their accounts are too loose and exaggerated to deserve much attention or faith, especially when they are at variance with the more sober and impartial accounts of the Greek and Roman historians: on these, therefore, we shall mainly and most confidently rely, for what we shall advance on the subject of the Druids, and Druidism.

I. With respect to the etymological derivation and meaning of the word Druid, it will not detain us long, as it is rather a matter of curiosity than of real importance. The most common and popular opinion is, that Druid is derived from the Greek word δρυς, an oak; but as the name evidently was borrowed by the Greek and Roman historians from the Celtic, and was, in fact, that which they found given to the Celtic priests by the people of that nation, and not what the Greeks or Romans conferred upon them, we must look to the Celtic language for its origin and meaning. It is rather singular, that, in this language, drys has the same meaning as δρυς in Greek, both signifying an oak. As we know that the Druids paid very particular veneration to the
oak, this derivation of their name seems to be the most natural and well founded; though it might be a subject of curious, as well as interesting and useful inquiry, whether the Celtic term *drys* was derived from the Greek, or the Greek word *dryas* from the Celtic. There is, however, another Celtic derivation of the word Druid, which requires to be noticed. In the Gaelic dialect of this language, *druidh* signifies wise men; and in the more ancient and pure dialect of the Welsh, *dryg* and *dreythe* signify persons conversant in diabolical arts, or magicians. The term, in this meaning, is also found in the Irish dialect; for in the translation of the Scriptures into that language, these words occur in Exod. vii. 7; Lev. xi. 9; Neh. xiii. 3; and in Samuel, chap. i. 8, in Acts, chap. ii. ver. 1, 7, and in the Acts of the Apostles, chap. viii. ver. 9. They are, indeed, a little different in their mode of spelling, but evidently the same word. In Math. chap. ii. ver. 1, the Irish word is *druighi*; and the correspondent word in the Welsh translation is *doethian*, which differs more from the usual term than any other word applied to magicians in any of the other dialects of the Celtic, or even in the Welsh in other places. The only question therefore is, whether the Druids were more likely to receive their name from the Celtic word signifying an oak, or from that which signifies wise men, or magicians; and, upon the whole, we are disposed to accede to the former opinion, in the first place, because the term *drys* comes nearer the word Druid; and, in the second place, because the appellation given to their priests was more likely to be derived by the Celts, from what peculiarly distinguished their religion, than from what was common to it with all other religions; now, the superstitious worship of the oak was undoubtedly one of the most marked and decisive peculiarities of Druidism, and therefore it is more probable that the name Druid was derived from *drys*, than from a word that signified wisdom, a qualification which all nations, however barbarous, ascribed to their priests. After all, however, as we before remarked, this is a question of comparatively little curiosity or importance, and we shall therefore dwell no longer on it, but proceed to consider the origin of Druidism.

II. Diogenes Laertius, on the authority of Aristotle and Soteron, ranks the Druids of the Celts and Galata with the Magi of the Persians, the Chaldceans of Babylonia, and the Gymnosophists of India; and hence some authors have inferred that Druidism took its origin from one or other of these nations: but this author merely means to give it his opinion, that the Druids, and the priests and wise men of Persia, Babylonia, and India, were similar in character and privileges, and that the Druids among the Celts possessed the same rank and office as the Magi in Persia, the Chaldceans in Babylonia, and the Gymnosophists in India. From this passage in Diogenes Laertius, therefore, nothing can be inferred respecting the origin of Druidism. The next opinion which we shall notice and examine on this point, is maintained by Baxter, Horsley, Macpherson, and Pinkerton, and requires more particular investigation, both on account of the authority and support which the names of these authors may be supposed to lend it, and because it is in itself not destitute of plausibility. This opinion is stated by Mr. Pinkerton, and is strongly and emphatically: "Druidism was palpably Phoenician." This short and dogmatic sentence occurs in the 1st volume of his Inquiry into the History of Scotland, p. 17. He adverts to it also in the 62d page of his Dissertation of the Galte, where he conde-
and Phoenicians is very remote and questionable, and as there are strong presumptions against the hypothesis, arising from other circumstances, it ought to be rejected.

The next hypothesis which we shall state and examine, maintains that the Gauls were taught Druidism by Pythagoras. This, like the other, rests on the similarity between the doctrines of this philosopher and those of Druidism, and on the alleged direct evidence of the fact. With regard to the first species of proof, it may be remarked, that the points of resemblance between the religious opinions of Pythagoras and the Druids are not so numerous as those which are brought forward by the advocates of the hypothesis already rejected; but one of them, at least, is more decisive and striking. It may be doubted whether the Phoenicians actually believed in the doctrine of transmigration; but this, it is well known, was one of the peculiar tenets of Pythagoras: but, as was before observed, the transmigration held by the Druids (if they actually believed such a doctrine) was very different from the transmigration taught by Pythagoras, as we are expressly informed by Caesar: *In primis hoc volunt persuadere, non interire animas, sed ab aliis post mortem transire ad alios: atque hoc maxime ad virtutem excitari putant metu mortis neglecto.* That by this Caesar meant that they believed only in the transmigration of the soul into a human body, is evident, by the practical use which they made of their doctrine; for to believe that their souls might pass into the bodies of inferior animals, could hardly have taken away the fear of death. But, independently of this consideration, we know that the doctrine of the transmigration of the soul was by no means peculiar, either to Pythagoras or the Druids. Indeed, it is one of those religious opinions, into which mankind, in a state of ignorance, are by no means unlikely to fall. The direct evidence that Pythagoras taught his doctrines to the Druids, rests principally, if not exclusively and entirely, upon the following passage in Ammianus Marcellinus: *Speaking of the Bards, Enabaes, and Druids among the Gauls, he says: Inter hos Drudee ingeni celsiores, ut autritas Pythagorae decrevit, sodalitii adstricti consorciis, questionibus occultarum rerum altarumque eecti sunt, et despectantes humanae, promnliarat animas immortales.* In order that the full and just authority may be given to this passage, it ought to be observed, that Ammianus is here quoting from Timagenes, a Greek historian, who lived in the time of Augustus, and who, both on account of the period at which he wrote, and the researches he made, must have been a more competent authority than Ammianus himself, who flourished when Druidism was nearly if not entirely extinct. Of the researches of Timagenes respecting the Gauls, Ammianus speaks in the following terms: *Ambigentes super origine prima Gallorum scriptores veres, notitia reliquere neglii semiplenam: sed postea Timagenes et diligentia Gracae et lingua, quae diu sunt ignotara, collegit ex multiplicantibus libris; cuius fidum sequi, obscurata dimita, cedem distincte docibus et aperte.* Having thus given the passage from Ammianus Marcellinus, respecting the supposed Pythagorean origin of Druidism, all the authority and weight which it deserves, and which it does not seem to have met with when simply considered as resting on the information of that historian, we shall now proceed to examine its tendency, import, and bearing, on the point in question. In the first place, the passage may merely mean, that the Druids, in the establishment of confraternities, resembled the Pythagoreans; though it must be confessed, that, by the obvious meaning of the words, Timagenes gives it as his opinion, that the Druids acknowledged the authority of Pythagoras; but that the former interpretation, notwithstanding this, is more natural, will probably be admitted, when we reflect, that this author is completely silent respecting the Pythagorean origin of the Druidic doctrine of transmigration; a point of resemblance between the two religions, which would have much more clearly and decidedly proved the authority of the philosopher, than the establishment of confraternities—the investigation of profound and lofty subjects, and the belief in the immortality of the soul. This interpretation of the passage is further illustrated and confirmed by what Diodorus Siculus says respecting the religion of the Celts. *The opinion of Pythagoras prevails among them, that the souls of men are immortal, and live again after a certain period, entering into different bodies.* In fact, the expressions of Diodorus Siculus, *invicti, que nobis a Pythagore locae,* and of Timagenes, very nearly coincide, and may be supposed merely to mean a resemblance between the doctrines of Pythagoras and the Druids, without asserting any thing respecting the origin of the one from the other. It is also worthy of remark, that though Diodorus Siculus mentions the transmigration of souls, in connection with Pythagoras, he does not even hint, that this doctrine was borrowed by the Celts from that philosopher.

It appears to us, that it has happened to those antiquarians who have searched for the origin of Druidism among the Phoenicians, Pythagoreans, &c. as it frequently happens to men in the common occurrences of life: they have missed what they have been in search of, by directing their enquiries too profoundly, or too remotely; and the desire of finding out an origin, not obvious to common enquiries, has led them astray from the truth. On the subject of Druidism, we must either entirely reject, or we must abide, by the authority of the Greek and Roman authors; especially the latter, for the Greek historians and geographers evidently borrowed from the former every thing regarding Druidism. Where these authors express their opinion, clearly and decidedly, it is assurredly as well worthy our regard and belief, as the unfounded hypothesis of the moderns; in whom it is very unfair to disregard or reject the testimony of the ancients, on this subject, when it does not accord with their hypothesis, and to quote and rely upon it only when it serves to illustrate or strengthen them. Now, with respect to the origin of Druidism, Caesar, certainly the best authority we could have, expresses himself in terms most distinct and positive: *"Disciplina in Britannia reperta, atque in Gallia translata esse existimatur;" and as a proof of the truth of this opinion, he says: *"et nunc, qui diligentius caut vel cognoscero voluerit, pleuranque illeo, discendii causa, perficiensur.* From the expressions of Caesar, it is reasonable to conclude, that he had taken some pains to learn the general belief in Gaul, respecting the origin of Druidism; and indeed, we know that his inquiries were very minute and diligent respecting every thing connected with this country, and that what he has written concerning it may be depended upon. Here then we have the positive testimony of Caesar, that, in his time in Gaul, Druidism was supposed to have originated in Britain; and that the belief in this opinion was so prevalent and strong, that such of the Gauls as wished to learn the more secret mysteries of Druidism, went over into Britain for that purpose. We
certainly cannot look for, or expect, any testimony on this subject more direct and satisfactory than that of the people who professed Druidism; for it ought always to be recollected, that it is not the opinion of Cæsar, but the opinion entertained in Gaul, which the passage we have quoted gives; and those who contend that Cæsar was mistaken in asserting that Druidism originated in Britain, (among whom may be particularly mentioned Smith in his Gaelic Antiquities, who talks of it as a conjecture or inference of Cæsar's,) ought to be instructed that the error, if it be one, proceeded most probably from the Druids themselves. On this point, therefore, we have as clear and direct evidence as we can possibly expect; and without bewildering ourselves in conjectures respecting the source from which Druidism proceeded into Britain, we may conclude that this country was one of its most ancient, if not its original place of abode.

III. The fact that Druidism originated in Britain, if it be allowed to be sufficiently established, will remove many difficulties respecting the countries in which it prevailed; for if it were originally British, we are not justified in concluding that it is essentially and radically Celtic. "Since it must have begun to exist long after the Celts left their original settlements, it must be considered as British, not Celtic; and it would be as absurd to extend it to all the Celts, because it originated among one branch of them, as it would be to expect to find the institution of secret tribunals in the 18th century, among the Swedes as well as among the Germans, merely because they are both Gothic nations. The supposed necessary connection between Celtic population and Druidism, has prevented antiquarians from examining the question, respecting the countries in which it can actually be proved to have existed, with clearness and impartiality." (Edinburgh Review,July 1803.) There is only one objection, which, in our opinion, can be brought against the hypothesis, that it is strictly speaking British, and not essentially Celtic; if it were so, it is not easy to account for its adoption by the Celtic tribes of Gaul; for it is not likely that they would borrow a religion from the Britons. Perhaps the truth may be, that Druidism existed in its most ancient and pure state among the Celtic tribes of Britain, who, inhabiting a country to the west of Gaul, may be supposed to have been a more ancient family of Celts, than those who inhabited the latter country, and therefore resorted, as the parent stock, for the purpose of initiation in the more solemn and secret mysteries of religion. This conjecture, however, must be confessed, is at variance with the British origin of Druidism.

The two grand and leading points of enquiry respecting the countries in which Druidism actually prevailed, are, whether all the Celtic nations were Druidic, and whether it is to be found in nations not of Celtic origin? We are persuaded that there is no evidence of the existence of Druidism any where, except in Celtic Gaul, and in part of Britain; and that Mr. Pinkerton is perfectly correct in maintaining, that the Druids were "not known beyond present North Wales on the north, and the river Garonne, the bounds of the Celte in Gaul, on the south. A line drawn by the Severn in Britain, and the Severn in Gaul, forms the eastern bound, while the ocean forms the western." (Pinkerton's Enquiry, vol. i. p. 406.) On this point, as on the preceding ones, we must examine the positive authority of the Greek and Roman historians, where it is to be found, and also the presumptive evidence, drawn from other sources. Cæsar, in his account of the Druids in Gaul, states, that they were accustomed to meet annually on the borders of the territory of the Carmites, which was regarded as the middle region of Gaul. Now, in the first place, by the word Gaul, when used by itself, this author almost invariably means Celtic Gaul; and in the second place, besides his common usage of the word, it is plain that Celtic Gaul must have here been meant, since the Carmites cannot, with any propriety, be considered as Druidical, if Aquitania and Belgic Gaul were included. Besides, Cæsar, in the very commencement of his description of Gaul, informs us, that the inhabitants of the three divisions differed totally in language, institutions, and laws; and in another place he says, that the Belgic were of German origin; but from the same authority, we learn, that the Germans had no Druids. Hence, it may fairly and satisfactorily be inferred, that Druidism was confined to the Celtic division of Gaul. We shall now examine the principal ancient authorities respecting the actual site and limits of Druidism in Britain; and in the first place, it is worthy our particular notice, that "Cæsar, though he describes the Druids in Gaul so minutely," though they appear to have excited his particular attention and curiosity, "and though he mentions the received opinion, that their institutions had originated in Britain, and were, even in his time, taught there with more strictness and purity than in Gaul, yet gives not the least hint, that while he was in Britain, he had seen any Druids, or collected any information concerning them." (Edinburgh Review.) The inference is obvious and indisputable. In those parts of Britain which Cæsar visited, Druidism did not exist; nor is it likely, if it had ever flourished there, that such a circumstance would have escaped his investigation. The first, and the only authority, we believe, who mentions the existence of Druidism in Britain, is Tacitus: in his annals of the transactions of the Romans in this country, does he mention it, till they had advanced as far into Wales as the island of Anglesey. In his life of Agricola, where he has detailed all the particulars respecting Scotland, with which, it may be supposed, that general supplied him, he makes no mention of Druidism. As the superstitions and ceremonies of the Druids, by their singularity and cruelty, actually appear to have excited, in a very strong degree, the curiosity and abhorrence of the ancient writers, we may justly conclude, that their silence respecting them, is a sufficient proof that they did not exist in the countries which they describe. With respect to Germany, and other countries not generally deemed Celtic, in which, according to some antiquarians, Druidism prevailed, as there is no direct authority for this opinion, it will be more properly considered in the following observations on the presumptive evidence for the existence of this religion beyond the limits which we have prescribed for it.

The first mode by which many antiquarians endeavour to prove that Druidism prevailed over a large portion of Europe, displays a remarkable want of logical correctness. "Wherever authorities for its existence in any country, which they deem Celtic, are not to be found, they appeal to the stone monuments, which, they say, are to be discovered exclusively in countries formerly inhabited by the Celts. Or, on the other hand, assuming it as a fact, that all the Celts were Druidical, they regard these remains of antiquity, as a sufficient indication, that the country in which they are found, was formerly the seat of a Celtic population. All the parts of this argument are assumed. But even if we allow the truth of both the circumstances upon which it is founded; viz. that all the Celts were Druidical, and that
the Druids erected enormous stone temples or altars, still it by no means follows that the countries in which these exist were formerly Druidical, or even Celtic. Stone monuments, nearly similar in form, and equal in magnitude to those which are said to be most unequivocally Druidical, are found in countries, into which, according to the opinion of all antiquaries the Celts never penetrated. In many parts of the North of Germany, in the island of Zealand, and in Iceland, the stone monuments are similar in form, and seem to have been erected for the same purpose with those in Britain and France." Edin. Review.

The presumptive argument, therefore, drawn from these stone monuments, must be abandoned as untenable; but there are arguments advanced for the existence of Druidism in Germany, of a different kind, which require to be noticed and examined. The passage in Caesar has already been adverted to, in which he expressly states, that the Germans had no Druids: His words are; Germani nullum ab hominibus disserunt; nam neque Druides habent, qui rebus divinis prae- sint, neque sacrificium transit. Yet notwithstanding this clear and decisive authority, it is asserted by many writers, that Caesar was mistaken; and they charge him with ignorance or error, in consequence of what Tacitus says respecting the religion of the Druids. There can be no doubt, if this latter writer differed from Caesar on this point, that his evidence ought to outweigh that of Caesar's, since he had more and better opportunities of learning the religion and institutions of the Germans: but as the evidence of Caesar is clear and decisive, that of Tacitus ought to be equally so, before it can fairly be set up in opposition to his. But all that he says respecting the priests of the Germans, is, that they alone possessed the power of imposing silence in their public councils, and of reproving or punishing offenders; and that they were always present in their wars. In these respects, they undoubtedly resembled the Druids; but they also resembled the priests of most other savage nations: there is no proof that they resembled the Druids in what was peculiar to them. Other antiquaries endeavour to prove, that Druidism existed in Germany, by the alleged identity of the German and Celtic religions, in several of their fundamental and peculiar points. The veneration for the misletoe certainly distinguished the Druidic religion: and if it could be shewn that the same veneration was paid to it in Germany, the argument would be of considerable weight; but in the Edda, it is uniformly represented either as a contemptible or mischievous plant. It is indeed not often mentioned; but where it is, it is held forth as the instrument of evil, not as the instrument of good, as among the Celts; and the learned and ingenious translator of Mallet very appositely remarks, that it was probably held in contempt and abhorrence by the German tribes, because it had been the object of veneration among the Celts, whom they had conquered and expelled.

The most plausible argument, however, for the German veneration for the misletoe, is advanced by Keysler, who says, that the word guthyl, used by the vulgar in Upper Germany at Christmas, as they run through the streets, is the exact translation, or, to speak more correctly, the original of the omina sanans, by which, according to Pliny, the Gauls expressed the misletoe. But to this it may be replied, that, by Keysler's own account, the misletoe is not employed when these words are used; and they may most naturally be considered as referring to the birth of Christ, the literal meaning of them being bona salus, not omnia sanans. It is worthy of observation also, that Keysler mentions the reverence paid to the misletoe in Gaul and Aquitaine, where the appellation for it is gay; and certainly in this word, as existing in a Celtic country, rather than in a German word, we ought to look for the original of Pliny's omnia sanans. But even allowing that traces of veneration for the misletoe were to be found in Germany, it would by no means prove, that Druidism was anciently the religion of that country: for, as has been already remarked, as the Celts were the original inhabitants of that part of Europe, if they were Druidical, relics of that religion may be supposed to have remained among their Gothic conquerors. In many parts of England, the rural custom is still observed of hanging up a misletoe bush on Christmas eve, and trying lots, by the cracking of the leaves and berries in the fire on the twelfth night, though, as we have proved, even so far back as the invasion of the Romans, Druidism had been expelled and confined to the western part of Wales.

The next supposed point of resemblance between the Druidical and German religions, from which it is inferred that Druidism ancienly prevailed in Germany, consists in the belief of the transmigration of the soul. There is only one passage which seems to favour this resemblance, and that, if examined, will be found in fact to make strongly against the opinion that the Germans were Druidic. The passage occurs in an ancient Ode, in the Edda of Snorri Sturluson: "Sigruna is dead through sorrow and grief. It was anciently believed that men were born again, but this now is accounted an old woman's fable." The same observation may be applied to this passage, which was applied to the inference of Keysler respecting the misletoe. The Goths were disposed to treat with contempt the opinions and institutions of their vanquished and expelled foes the Celts; and to them most probably the author of the Ode refers, when he speaks of the opinion of transmigration as being ancienly held, but, as in his time, being esteemed an old woman's fable. That the Gothic tribes did not believe in the transmigration of the soul, innumerable passages from the Edda might be cited to prove, all of which describe a fixed elysium and a hell, where the valiant and the just were rewarded, and where the cowardly and the wicked suffered punishment. Besides the utter discrepancy of the religious opinions of the Druids and Germans in this point, they were totally dissimilar, as Dr Percy has shewn, in his introduction to his translation of Mallet, in many other important and essential ceremonies and doctrines. Not only therefore the direct testimony of the ancients, but all presumptive evidence, is against the hypothesis that Druidism existed in Germany.

The only other countries in which Druidism is presumed to have existed, are Ireland and Italy; but the examination of their claims will not detain us long. Respecting the existence of Druidism in Ireland, the ancient authors are wholly silent; indeed they were very little acquainted with this island. But the Irish antiquaries are loud and positive in their assertions, that their country not only had Druids, but that it was their principal and favourite abode, and that even in the time of St Patrick they were flourishing and abundant. But the authorities for these positions are little better, in point of validity and genuineness, than those which are brought forward in support of the Milesian colonization, and antediluvian dynasty of Ireland. In the introduction to the study of the history and antiquities of this country by Mr O'Halloran, we have a most charac-
teristic instance and proof of the manufacture of Irish authorities, which may well excuse us from examining laboriously or minutely their claims to Druidism. This author, indignant at the opinion expressly supported by Caesar, that the religion of Druidism was invented in Britain, without scruple alters the text of the Roman historian, and supposes that he wrote, not "disciplina in Britanniæ reperta," but "disciplina insulis Britannia reperta." This he calls clearing up and illustrat- ing the passage. Rowland, in his Mona Antiqua, sup-
poses that when the Roman general attacked the Druids in Anglesey, some of them fled over into Ireland; but for this supposition there is no authority.

With respect to Italy, the only work, as far as we know, in which it is asserted that Druidism had taken root there, is the Ancient Universal History. In the 19th volume of this work, page 78, the authors say, "The sect and religion of the Druids spread as far as Italy; for Augustus published an edict, forbidding the Romans to celebrate their mysteries." It is surprising how writers in general, so accurate and well-informed, should have fallen into this error; for, by a reference to Suetonius, it will be found, that by this edict the use of their religious ceremonies in Gaul was prohibited; and this prohibition, as well as the subsequent edicts of Tiberius and Claudius for the same purpose, seem to have been issued, in consequence of the abhorrence which the Romans felt towards the horrid usages of Druidism.

IV. The Druids were divided into several ranks and orders, respecting which Caesar informs us, that some of them were more eminent than others, and that over the whole there was one supreme head, or arch-druid. This person was chosen from among those who were most distinguished and eminent for their knowledge of the mysteries of Druidism, by a plurality of votes; and as the station brought with it considerable emolument, as well as power, and was favoured with high and pecu-

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numerous and important: in fact, they seem to have possessed the supreme authority, and to have controul-
led and directed the plans and operations of the sove-
reign. According to Caesar, "no sacred rite could be performed, except a Druid were present: by means of them, as the favourites of the gods, and the depositaries of their counsels, the people offered up their thanksgivings, sacrifices, and prayers; and submitted with the most implicit veneration to all their commands." He adds, that so great was the respect paid to the character of the Druids, that when two hostile armies, inflamed with rage, with their swords drawn and their spears extended, were on the point of engaging, if the Druids interfered, they sheathed their swords, and became in-
stantly calm and peaceful. Their persons were estem-
ed sacred and inviolable; they were exempted from all taxes and military services; they exercised a civil and criminal jurisdiction; those who did not obey their de-
crees, were interdicted the sacrifices, after which, no per-
son dared to hold communication or converse with
them, so that this punishment was reckoned severer than death itself. The Druids had the privilege of wearing white garments, which all other classes were expressly forbidden to do. At their yearly court of ap-
peal, which, according to Caesar, they held in the terri-
ory of the Carnutes, they held their sittings in a consec-
ated grove; and before them all who had any private
suits or controversies appeared, and considered them-
selves obliged to submit to their decrees and sentence. In order to increase the public respect and veneration for them, they appeared to have lived in a retired man-
er, either singly or in fraternities. We have no accu-
rate information respecting the means by which they were supported; but, as the administration of justice, the practice of physic, and the mysteries of religion, were exclusively in their hands, it is reasonable to sup-
pose, that from these sources they derived consider-
able emolument. Toland, in his history of the Druids, mentions a tradition, which, if authentic, would like-
wise be the means of increasing their revenues, while it seems to be confirmed; for he explains the word senex, which, according to him, was given to them by the Lat-
in term senex.

Besides the male Druids, there were also Druidesses, who, like the former, were divided into three classes. The first lived together in sisterhoods apart from the world, having vowed perpetual virginity. They were much resorted to and venerated by the people, on ac-
count of their supposed powers of divination. Acc-
ding to some of the Druids, it was characteristic of Tiberius and Claudius for the same purpose, seem to have

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flamed with rage, with their swords drawn and their spears extended, were on the point of engaging, if the Druids interfered, they sheathed their swords, and became instantly calm and peaceful. Their persons were esteemed sacred and inviolable; they were exempted from all taxes and military services; they exercised a civil and criminal jurisdiction; those who did not obey their decrees, were interdicted the sacrifices, after which, no person dared to hold communication or converse with them, so that this punishment was reckoned severer than death itself. The Druids had the privilege of wearing white garments, which all other classes were expressly forbidden to do. At their yearly court of appeal, which, according to Caesar, they held in the territory of the Carnutes, they held their sittings in a consecrated grove; and before them all who had any private suits or controversies appeared, and considered themselves obliged to submit to their decrees and sentence. In order to increase the public respect and veneration for them, they appeared to have lived in a retired manner, either singly or in fraternities. We have no accurate information respecting the means by which they were supported; but, as the administration of justice, the practice of physic, and the mysteries of religion, were exclusively in their hands, it is reasonable to suppose, that from these sources they derived considerable emolument. Toland, in his history of the Druids, mentions a tradition, which, if authentic, would likewise be the means of increasing their revenues, while it
also further exemplifies the firm hold which they possessed over the superstitions of the people. According to this writer, the priests of the temple within whose district a family dwelt, exacted from all the members of it certain annual dues; and in order to insure the punctual and regular payment, every family was obliged, under the penalty of excommunication, to extinguish their fires on the last day of October, and to attend at the temple with their annual payment. If they paid the tribute, they received some of the sacred fire from the altar on the subsequent day; but if they failed in their payment, they were deprived of the use of fire during the whole winter. In consequence of these powers, privileges, and immunities, and of the great wealth and influence which they possessed, princes were ambitious of being admitted into their society, and many children were dedicated to the service by their parents.

VI. The Druids had two sets of religious doctrines and opinions; the one made known only to the initiated, who, on their adoption, took a solemn oath to keep this system of doctrines a profound secret. In order that these more sacred and mysterious doctrines might be still more carefully preserved from the vulgar, Pomponius Mela informs us, that they taught their disciples in the caves of the earth, or in the deepest recesses of the most gloomy and sheltered forests; and they never committed any of these doctrines to writing. Of course, respecting the nature and purport of these, we have no positive information, unless what Mela says be correct. "There is one thing which they teach their disciples, which has also been made known to the common people, in order to render them more brave and fearless; viz. that the soul is immortal, and that there is another life after the present." According to Cæsar and Dio-dorus Siculus, they also taught, as one of their esoteric doctrines, the transmigration of the soul. To this doctrine we have already had occasion to allude; and we remarked, that it differed from that of Pythagoras, in supposing that the transmigration was only from one human body to another. We also observed, at the same time, that there was some reason to doubt, whether they actually did believe in transmigration of any kind. This doubt is founded on the passage of Pomponius Mela, in which he states, that they believed in the immortality of the soul, and a future life; and that when they buried the ashes of the dead, they also buried their books of accounts, and the notes of hand of the money they had lent when alive, that they might be of service to them in the other world. This practice was certainly very incompatible with the belief, that their souls after death would pass into other bodies, and again live on the earth. Their public religious doctrines were exceedingly numerous; but they chiefly related to the most ridiculous or trifling matters. The sum of their moral doctrine, according to Diogenes Laertius, consisted in doing good, worshiping the gods, and exercising fortitude.

VII. We have no direct and clear evidence respecting the gods whom the Druids worshipped; but, from the accounts of the Celtic deities given us by the ancients, if Druidism were radically and essentially Celtic, we may suppose that the deities principally worshipped by the Druids, were Esus, afterwards called Jupiter, who, under his original character and name, was worshipped under the symbol of an oak, or even a shapeless stump of a tree; -- Mars, to whom they gave the name of Segonum, and who was regarded as their chief protector; -- Apollo, who was worshipped under the name of Rictenus, whom they regarded, not only as the sun, but as the god of medicine, and to whom they dedicated an herb called Belimunica, supposed to have been a species of henbane; -- and Mercury, whom they called Omnus, and worshipped as the god of eloquence, and of trade, and as an infernal deity.

VIII. The most horrid of the superstitious rites of the Druids consisted in human sacrifices. These, however, were offered up only on the most solemn and important occasions. The victim or victims, for there were sometimes several, were inclosed in a large figure resembling a man, formed of osier twigs; or, according to some authors, they were simply wrapped round with hay. In this state, fire was applied, and they were reduced to ashes. Pliny asserts, that they considered it as a part of their most solemn and most obligatory religion, to put men to death; and that to feed upon their dead bodies, they esteemed most wholesome. The human victims were in general selected from among the criminals; but when none of these were to be had, they did not scruple to sacrifice innocent persons. In some instances, it appears that this horrible superstition was practised, even for persons of high rank, when they were afflicted with any dangerous disease. The Druids paid particular attention to the examination of the animals which they sacrificed; and only the most perfect and beautiful were selected for this purpose. They also watched the manner in which the victim, whether human or brute, fell when it was stabbed; whether on his right or left side, or on his face; how the blood flowed at the wound, &c.; and from these circumstances, they pretended to foretell what was to happen.

These superstitions, however, were not peculiar to the Druids; but those which regarded the mistletoe and vervain, salago, and the serpent's egg, were characteristic of their religion. Respecting all these superstitions, Pliny gives us a very particular account. According to him, the Druids held nothing so sacred as the mistletoe of the oak: they believed that every thing which grew upon that tree, came from heaven. Whenever the mistletoe was discovered upon it, they went, with great ceremony and respect, to gather it. The sixth day of the moon was always chosen for this purpose. In their own language, the Druids called the mistletoe, all healing. As soon as they had prepared, under the oak, all the apparatus for sacrifice, and the banquet which they usually made, they tied, for the first time, two white bulls to it, by the horns. Then one of the priests, clothed in white, ascends the tree, and with a golden knife, cuts off the mistletoe, which is received in a white garment: after this, sacrifices are offered up. In another place he mentions the opinion of the Druids, that the mistletoe gave fertility to man and beast, and that it was a specific against all kind of poison. The same author says, that they pretended to predict future events, by means of the vervain; and that from it they extracted an ointment, which was efficacious, not only in preventing or curing all diseases, but also in conciliating friendships, and procuring the accomplishment of every wish. This plant they gathered at the commencement of the dog-days, and in a moonless night. The salago, a species of savin, they esteemed a preservative against every calamity, and the smoke of it beneficial for any complaints in the eyes. Their notions respecting the serpent's egg, (which are also detailed by Pliny,) were still more credulous and absurd. This egg was formed from the scum of a vast multitude of serpents, and secured
to the person, in whose possession it was, every thing which he could wish or desire.

1X. None of the ancient writers who describe Druidism, make any mention of temples; on the contrary, from the account which they give of the sacred grove, we may reasonably infer, that their religious rites were carried on in it alone, without the use of temples. "Tacitus, in his account of the destruction of the seat of Druidical superstition in the Isle of Anglesey, informs us, that the groves sacred to their cruel rites were cut down, as it evidently appears to have been the intention of Suetonius Paulinus to exterminate, if possible, the religion of the Druids, or at least to prevent them from continuing to offer up human victims; certainly, if temples had formed any part of their institutions, he would have destroyed them, as well as cut down their groves. No mention, however, is made of them by Tacitus; and if they did not exist in Anglesey, which is known to have been one of the most celebrated and solemn seats of Druidism, it is by no means probable that they were used in any other part of Britain." (Edin.

The notices contained in the ancient writers, on the subject of the philosophy and learning of the Druids, are neither very numerous, nor very explicit; and they prove rather their indulgence in speculative, than their advances in practical philosophy. Strabo says, that they taught the alternate dissolution of the world by fire and water, and its successive renovation: and Pomponus Mela infers, that they pretended to great knowledge of geography and astronomy; especially respecting the size and form of the earth, the motions of the planets, and their influence, as well as the influence of the stars; but from what this author adds, that by this knowledge they assumed the power of prying into futurity, we may safely infer, that their philosophy was of a very inferior and limited nature. Cicero mentions a Gaulish Druid, with whom he was personally acquainted, who professed to have a thorough knowledge of the laws of nature: and from the testimony of Caesar, it appears that they had many disquisitions concerning the heavenly bodies and their motions; but the nature or extent of their knowledge on these subjects we are utterly unacquainted with. It has been attempted to prove, that they were skilled in geometry, on the authority of Caesar; this author says, "that if any disputes arose among the Gauls, about their inheritances, or about the limits of their fields, they were referred to the decision of the Druids;" but reference was made to them, most probably, merely on account of the influence they possessed, not on account of their skill in geometry. We have seen, that whatever knowledge they possessed, or pretended to possess, in astronomy, was employed by them to preserve and strengthen the superstition of the people. Their knowledge of botany and medicine appears to have been turned to the same account. In short, if we coolly and impartially examine this subject, we shall find reason to conclude, that the Druids possessed no more philosophy or learning, than the priests of other religions in the same state of society; and that what they did possess, only served to confirm the ignorance and superstition of those whom it was their duty to have enlightened.

X. Of the philosophy and learning of the Druids, the most exaggerated and ridiculous accounts are given by those authors, who have consulted their imagination and prejudices, rather than the sober testimony of antiquity. According to them, the most wonderful and scientific discoveries of modern philosophy were known to the Druids; and their learning embraced a much wider compass than that of the sages of Greece or Rome. In the description of the Massilian grove by Lucan, just referred to, the poet mentions a report, that it was often shaken, and strangely moved; that dreadful sounds were heard from its caverns; that the yews, if thrown, or cut down, grew up again spontaneously; that the grove was sometimes in a blaze, without being consumed; and that monstrous dragons turned about the oak. It is easy to perceive in this description the fancy of the poet, adding to and embellishing those reports concerning the sacred grove, which it must have been so much the interest of the Druids to have propagatd, and which the ignorance and superstition of the people would not be indisposed to believe. Yet from this description, Mr. Smith, in his History of the Druids, prefixed to his Gaelic Antiquities, infers, that they were acquainted with the composition and use of gunpowder; "and," he adds, "if we consider the deep and long researches of these colleges of philosophers, their being possessed of the experiments of a series of ages before, and an extensive communication with other countries, we can hardly suppose the mystery of the nitrous grain could escape them," (p. 74.) Before we proceed to the more sober and rational accounts with which the ancients supply us, respecting the philosophy and learning of the Druids, we shall give one more instance of the prejudiced credulity on this topic, of those who have so largely contributed to mislead the world concerning this order of men. Diodorus Siculus, on the authority of Hecataeus, relates, that the Boreade, inhabitants of a certain Hyperborean island, little less than Sicily, lying opposite Celtiberia, saw the moon much nearer, and more distinctly, than other men. This passage is pressed into the service of the believers in the philosophy and science of the Druids; by the Boreade, it is contended, the bards were meant; the island evidently is Britain; and the British Druids were enabled to see the moon thus near and distinctly, by means of telescopes. Assuredly, these two instances (and many more might be given) bears us out in the assertion, with which we commenced this article, that on the subject of Druidism, there was great room and occasion for the most rigorous and sceptical examination.
Drunkenness.

It is stated in the book of Genesis, that Noah, soon after the flood, having manufactured wine, “drank of it, and was drunken.” This is the first instance of intoxication anywhere on record. Some have even thought that it is the first that ever occurred; and that Noah was the inventor of wine. But it is more likely, from the manner in which the sacred historian introduces the circumstance, as well as from the nature of the thing itself, that the practice of making wine was known to the antediluvians. It must, however, be confessed, that no mention is made of its use among them. But ever since the time of Noah, in all countries where fermented liquors have been known, the practice of drunkenness has been more or less prevalent.

Alcohol is the chief of the intoxicating substances; but there are others besides it which produce a similar effect. Such are opium and bangle, hemlock, nightshade, henbane, and tobacco. Nitrous oxide gas, applied for a few seconds to the lungs by means of breathing, induces a transitory sort of intoxication. Opium and bangle are used in Mahometan countries, where the laws of the prophet prohibit the use of wine. Bangle induces a sort of folly and forgetfulness, gaiety, and delirious joy. It and opium are, in truth, seducers for wine; for, in all countries, men constantly seek after something or other to rouse and exhilarate their spirits, and bring on that mental state which relieves them from every care. This disposition, however, prevails most in cold climates; for drunkenness is observed to increase in proportion as we recede from the equator. The stimulus of heat being deficient, it would appear, in cold climates, men feel more strongly the want of another stimulus, and are thus led to the excessive use of intoxicating liquors.

The ancient Germans were remarkable for their excess in drinking. And the celebrated modern traveller, Von Buch, gives us a most revolting picture of the propensity of the Laplanders to intoxication.

The state of civilization, too, has much influence on this practice. The most barbarous nations, ceteris paribus, are always the most drunken; and it is almost uniformly found, that as refinement makes progress, the habit of intoxication gradually loses ground. Not long ago in our own country, particularly in this quarter of the island, a man was deemed deficient in the duties of hospitality, if he did not make all his guests drunk before they left his table. Now, on the contrary, every man drinks or not as he pleases; and there is no compelling, as formerly, every guest to swallow the same quantity of liquor, whether he be strong or weak, healthy or delicate.

Sacred writ condemns drunkenness in the most pointed terms. It is a vice most degrading and disgraceful even in our own sex, but in the other, no language can express its deformity and abomination? The Romans put women to death, who were convicted of getting drunk. It is a crime, by our laws, punishable with 5s., of a fine, or sitting six hours in the stocks, and is accounted an aggravation of any other offence.

Drunkenness may be considered in a twofold point of view; either as a single paroxysm, or as a habit induced by a repetition of these. The paroxysm consists of two stages, that of excitement, and that of relaxation. The stage of excitement begins with an increase of heat and muscular strength, and of vigour in the circulation of the blood. The eyes sparkle, the face becomes redder, and the whole countenance is pressingly enlivened. The powers of imagination are vivid and strong; and an easy flow of spirits, with wit and humour, and a total forgetfulness of every anxious care, place the newly initiated votary of Bacchus in a paradise of pleasure. Dissipat Evius auras edaces. Love and joy, and agreeable emotions, exclusively take possession of him. The shady sides of objects are everywhere turned away, and the beauties he formerly admired are arrayed in gayer colours. All is pleasure and delight; and man is now elevated above the sphere of mortals. When arrived at this point, however, he seems to have reached the verge of cheerfulness and decency; all beyond is madness and confusion. Noise and ribaldry usurp the place of mirth, and a propensity to muscular exertion shews itself in various ways, such as dancing or wrestling, the rude squeeze, or the odd mistedulation. The song and the laugh become louder and more boisterous, and the talkers pass rapidly from one subject to another. Everything now indicates a degree of excitement totally incompatible with the mens sana in corpore sano. The weaknesses of the soul are unveiled;

Condita cum verae operis precedit Libris.

In vino veritas, says the proverb. No constitutional strength, no caution or resolution, can now sufficiently guard us against the exposure of our mental frailties.

Yet still, as Dr Trotter has finely remarked, in his Essay on the subject, “the cultivated mind is seen even in drunkenness. It commits no outrage, provokes no quarrel, and turns its ear from insult and offence. But the ignorant and iliterate man is to be shunned in proportion to his excess; it is human nature in its vilest garb, and madness in its worst form.”

Though the adage already quoted, in vino veritas, or that people often discover in drink what they would otherwise have concealed, is no doubt true in a certain sense; yet there is another sense in which it is by no means so. The sentiments a man utters, when he is intoxicated, are no sure indications of the natural dispositions of his soul. On the contrary, he is then beside himself, and in a state of delirium. He sees objects through a medium which gives them a false and unnatural appearance, and hence he seems to betray qua-
Drunkenness.

The phenomena of intoxication vary both with respect to the sort of liquor drunk, and the temperament or natural disposition of the person who drinks. Much more, however, seems to depend on the last of these circumstances than on the first. Wine, spirits of every kind, porter, strong ale, cider, perry, malm, mead, purl, koumiss, all owe their intoxicating quality to the alcohol they contain; and the liquors called liqueurs, are nothing but alcohol variously disguised.

If the inebriating liquor continue still to be applied, the high degree of excitement before described, will very soon terminate in a frightful state of relaxation. This is easily explained by a well-known law of the animal economy, that all excessive stimulation is followed by debility. A degree of paralysis or palsy now takes place over the whole frame, and the mental debility corresponds to the relaxation of the body. Objects make little impression on the senses; the passions are weakened; the understanding darkened, and the conceptions being incoherent and confused, the drunkard either remains silent, or mutters an unintelligible soliloquy. He now for the most part soon falls into a profound sleep, and sometimes an apoplectic stertor marks the oppressed state of the brain. When this is the case, the symptoms are not to be distinguished from those of true apoplexy, otherwise than by a knowledge of their remote cause. But this is sometimes unknown, and can only be conjectured from the smell of liquor in the breath, or the ejection of it from the stomach. The person is now, in vulgar phrase, said to be "dead drunk;" and this sometimes turns out to be literally true, for real apoplexy, palsy, or convulsions, at times supervene, and conclude the scene. In a person dead drunk, the only signs of life are the stertorous or snoring respiration, with the pulse full and slow; and the warmth of the body still remaining. The usual way, however, in which the drunken paroxysm goes off, is by a few hours sleep, during which the alcoholic stimulus is either evacuated by perspiration, vomiting, or urine, or is somehow neutralized by the action of the system. The drunkard then awakes with a feeling of low spirits; of nausea and loathing of food, of languor and head-nach; seldom with any recollection of what has passed.

When death has been the consequence of the drunken paroxysm, dissection has shown the brain to be exactly as it is found in true apoplexy. Morgagni has related several such cases.

The power of resisting cold and contagion, and a want of sensibility to pain, has been often observed to be surprisingly great in persons intoxicated. In this respect they resemble maniacs.

It is, however, during the first stage of the drunken paroxysm only that this resistance to cold takes place; and the same may be said with respect to contagion. This we know to be always strongly resisted by that firmness and resolution of mind which necessarily accompanies a vigorous circulation of the blood.

The insensibility of the inebriate to pain, is strikingly remarkable. Drunk people fall off their own feet and off their horses, with greatly less injury than others usually do. Sailors, says Dr Trotter, whose heedless revels expose them to more disasters than other men, frequently receive the most frightful wounds and bruises, without the smallest signs of feeling, and without any recollection afterwards of the manner in which they were inflicted.

The symptoms we have hitherto described are those which usually appear in persons not addicted to a habit of drinking; but with such as are, they vary considerably. One great point of difference is, that the pleasant feelings at the commencement of the drunken paroxysm are by no means so strong in them. For by frequent repetition, the relish for wine is blunted; and while the desire for the application of the stimulus is augmented, the pleasure arising from it is diminished. And this is what distinguishes a temperate man from a sot.

The effects of inebriating liquors will be very different at different times. They will vary with the habit of intoxication, the fulness or emptiness of the stomach, the time of the day, the heat of the climate, the season of the year, the temperature of the room, and in short with whatever tends to vary the excitability of the system. Every person knows, that less liquor will produce intoxication in the forenoon than after dinner; and we learn from Captain Bligh's narrative, that when he and his companions in an open boat in their passage to Timor, were, from a scarcity of provisions, reduced to a state of almost continued fasting, a single tea-spoonful of rum produced inebriation. This state of the system has been called accumulated excitability. But in typhus fever it seems to be in a state directly opposite; for then two or even three bottles of wine will sometimes be used in the four-and-twenty hours, and that too by delicate females, without inconvenience.

When the stimulus of fermented liquors is frequently resorted to, the efficiency of it is gradually diminished; and to produce the same effect on the system, a larger quantity of the same sort of liquor, or else a similar quantity of a stronger sort, must be applied. For it is a law of the animal economy, that all stimuli, whether mental or corporeal, lose their effect by repetition. We may hence account for the charm of novelty in our gratifications, and how it comes to pass, that men of pleasure, who have exhausted every source of enjoyment by frequent repetition, are the most miserable of mortals, and exclaim in the bitterness of their hearts, that "all is vanity." They are seized by an ennui which nothing can relieve; and go about seeking gratification, without finding it.

Some of the strongest symptoms of the drunken habit, are a neglect of dress and cleanliness; a slovenly, sallow, or bloated appearance; and not unfrequently a sort of convulsive or paralytic motion in the gait, well known to most people. When any person once begins to shew these symptoms, we may fairly put him down as nearly in a hopeless state. Gout, and consumption, and diabetes, and water in the head, have perhaps been sometimes cured, though long and justly reckoned oppressa medicina; but the habit of intoxication exceeds even these diseases in obstinacy. It may indeed almost be said to be a "country from whose bourne no traveller returns." One perhaps in a thousand may escape the devouring gulf. Nowhere is the elegant allusion of the Jewish prophet more completely verified than here; "Can the Ethiopian change his skin, or the leopard his spots?" The habit of drunkenness is scarcely ever got the better of.

"It is not uncommon to hear people say that they have
known many hard drinkers live to a great age; and that if spirituous liquors be a poison, as physicians and moralists tell them that they are, they must indeed be a very slow poison, for such a person of their acquaintance has now attained his 80th year, for example, and yet has drunk hard all his life. This, however, is a very gross and most pernicious deception, much resembling the lists of remarkable cures said to be performed by quacks. You hear of those that have survived their prescriptions, but nothing of those who have perished. And from the nature of the thing itself, though we had nothing else to go upon, we might conclude even a priori, that such excess of stimulation must wear out the system, and hasten its decay. But we have other evidence,—we have the test of experience to shew that it actually does so, and that long-lived drunkards are only exceptions to a general rule. "On comparing," says Dr Willan in his Report of the Diseases of London, "my own observations with the bills of mortality, I am convinced, that considerably more than one-eighth of all the deaths that take place in persons above twenty years old, happen prematurely through excess in drinking spirits."

But it is not drinking always to the point of intoxication that is necessary to constitute intemperance. The health, as well as the mental faculties, may be ruined by a regular course of what some consider as sober drinking. Half a bottle or more of wine, for example, taken every day, is thought by many to do no harm. But perhaps the degree of constant excitement thus kept up, is more trying to the system, and ultimately more pernicious, than getting completely drunk would be at longer intervals. Dr Gregory, in his Lectures, gives it as his opinion, that of the two, a man had better drink no wine during the month, and then make himself completely drunk at the end of it, than swallow half a bottle of port every day, though he may never seem to be thereby intoxicated at all. Because in the former case the system has time to recover itself from the shock given it before it receives another; whereas in the latter case, it is constantly as it were kept upon the stretch.

Wine, however, and other alcoholic liquors, we do not prescribe altogether. It is only their abuse that we condemn. A certain dose, if we may so speak, of any of them, will frequently be attended with good effects, or will at least do no harm. But then it belongs to the prudence and judgment of a wise man, to regulate the quantity he uses, as much as it belongs to him to regulate the quantity of common food he takes; for by excessive indulgence in this as well as in the other, he will most certainly impair his health. It is impossible to give a general rule for the quantity of wine or spirits that may be safely employed in a given time. But we think that three or four glasses of wine, or one of spirits much diluted with water, daily, is as much as can be taken by most men without producing more or less injury to the system. We do not deny that many persons can use a great deal more than this without its bad effects being for a long while sensibly felt. We only say, that for the most part it will do rather harm than good. The quantity of spirituous liquor that can be swallowed undiluted at one time without endangering life, is not very great. But the writer of this article once knew a countryman of twenty-two years of age, who, for a wager of one guinea, swallowed at two draughts a quart bottle of proof spirit rum, and after he had done so, walked a mile home to his own house.

Vomiting then came on, and he recovered after a prettily severe shock to his constitution.

"Wine is an excellent remedy for some diseases; but why take physic when in good health? In the latter stage of typhus it is the best remedy we know; and as old age is considered by many as a disease also, it is (we do not say, a remedy) but a palliative for it too. No person, however, Dr Trotter thinks, if in good health, "can need wine till he be forty. He may then begin with two glasses a day; at fifty he may add two more; and at sixty he may go the length of six, but not to exceed that quantity, though he should live to an hundred." Such is a good rule for the abstemious, who have not early indulged in wine. Others may require more.

Not only poets, but physicians even of no less name than Haller and Hoffmann, have represented wine as favourable to mental vigour. This, however, is certainly a mistake. All those persons who have made the greatest improvements in works of genius, have been of sober and temperate habits.

We shall here put down a few of the most curious instances of mental hallucination, that have been ascertained to proceed from excess in drinking. Atheneus tells us, that a drunken crew at Agrigentum in Sicily, hearing the winds roar on the house in which they happened to be, became so fully persuaded that they were on board a ship, and in danger of suffering shipwreck, that they threw all the furniture out of the windows, under the idea that they were lightening the ship. A drunken man has been known to whip a post, because it would not move out of his way; and an old gentleman of eighty, when intoxicated, once took a lamp-post for a lady, and addressed her in all the impassioned and flattering language of love. "I have myself," says Junius, in his Character of Drunkards, "seen a scholar and a witty man, somewhat gone in drink, take up a sand barrel instead of a bowl of beer, in a grocer's shop, and having said, 'Here, cousin, to all our friends; hold it to his mouth till a great part of the sand ran in between his teeth.' He mentions another drunken man who was stopped in his progress by the shadow of a sign-post, which he thought it impossible to get over; and a third, who, seeing the moon shine through a small hole in the wall, attempted to light his candle at it. Another, he says, fell down drunk in Fleet Street, and when people offered to help him up, he exclaimed, 'What, can't I be quiet in my own room?'

Alcohol not only intoxicates, it also acts chemically on the human body. It constrains the dead animal solid, and retards putrefaction. It coagulates the serum of drinking the blood, and most of the animal fluids, and undoubtedly, in some measure, deoxygenates the blood.

Saussure junior has shown, that alcohol contains about 15 per cent. of hydrogen. Now that this gas, in the inebriate, is sent off in a disengaged state from the lungs, is evident from the factor of the breath. Indeed, it is sometimes so pure, that the breath of the drunk drinker will inflame on the approach of a candle.

It is well known that there are on record many cases of the actual combustion of the human body, produced by the long and immoderate use of alcohol. These have been collected in a curious memoir by Pierre Aime Lair in the Journal de Physique, Pluviocée, year 8th.

The reader who wishes for more information on this strange subject, we must beg leave to refer to the above document. It has been copied by Dr Trotter into his
Drunkenness.

interesting Essay on Drunkenness. It is remarkable, as has been observed by Pierre Aime Lair, that this sort of combustion occurred only in women far advanced in life.

The diseases brought on by drunkenness are so many, that we can do nothing more than barely enumerate them here. For their history and manner of production, we must again refer to Dr Trotter. He divides them into two sections;—those which appear during the drunken paroxysm, and those which are induced by the continued habit of drinking. His first section contains apoplexy, epilepsy, hysteria, convulsions, onerodynia. His second, phrenitis, rheumatism, pleurisy, gastritis, enteritis, ophthalmia, carbuncles, goutarosce, hepatitis or diseased liver, podagra or gout, scirrhous of the bowels, icterus or jaundice, dyspepsia or indigestion, hydrops or dropsy, tabes, atrophy or emaciation of the body, syncope, palpitation, diabetes or excessive discharge of urine, locked jaw, palsy, ulcers, madness and idiocy, melancholy, impotency, premature old age. A most formidable catalogue certainly, but all of which are shewn by him to be often induced by a too free use of vinous liquors. Dr Gregory has observed, that dram drinkers are peculiarly predisposed to gangrene or mortification.

In attempting to prevent or cure the drunken habit, venienti occurrite morbo, is a most invaluable maxim. Let every individual who has the least regard for his safety beware. Scarcely any thing can equal the danger of his once giving way. If he indulges ever so little the desire he may feel for the stimulus of vinous liquors, he is in the utmost peril of being ultimately undone. The enemy once admitted, will scarcely ever be afterwards expelled. Many a drunkard has the author of this article had occasion to observe; and among all the number who have fallen under his notice, he does not remember to have seen one of them in whom the habit was cured. Some, from external constraint, or the powerful influence of the fear of a superior, have been induced to remain sober for a considerable time, for months perhaps together; but universally did they relapse when the restraining cause ceased to operate. He once knew a gentleman of good family, so lost by the habit of ebriety, that he has seen him cry like a child when the lady of the house refused to give him a glass of whisky in the forenoon. Wine he little valued, as the sensibility of the nerves of his palate and stomach were so much blunted by excessive stimulation, that he could hardly distinguish it from water. If denied pocket money to procure whisky, he constantly pawned his shirts or other parts of dress whenever he had an opportunity. He died miserably at the age of 51, so dropatical, that for the last six weeks of his life he could not be removed from the sitting posture.

The cure of a confirmed habit of drunkenness, is, as we already said, hardly to be expected. It is so much a disease of the mind, that "herein the patient must," in a great degree, "minister to himself." But then so debased is the mind, so enfeebled, so enslaved, that it is altogether incapable of making the necessary efforts. It becomes the willing slave and victim of the foe.

Withdrew at once.

It is a question with some, whether, in the attempt to cure habitual drunkenness, it would be safe, even if the patient were willing, to leave off the use of wine or spirits all at once. Dr Trotter has no doubts on this subject. He does not think that there is any soundness in the reasoning, which would prove that it is dangerous to withdraw all at once the accustomed stimulus of alcohol. We daily perceive in all parts of the world, men who, by profligacy and hard drinking, have brought themselves to a jail; yet if we consult the records of the prison, we shall not find that any of these habitual drunkards died by being forced all at once to commence a sober course of life. "As far, (continues the Doctor) as my experience of mankind enables me to decide, I must give it as my opinion, that there is no safety in trusting the habitual inebriate with any limited portion of liquor. Wherever I have seen the drunkard effectually reformed, he has at once abandoned his potation." We think this very probable indeed, but at the same time are of opinion, that a habitual drunkard has been very seldom seen effectually reformed.

See Trotter on Drunkenness; Lettsom on Hard Drinking; Willan's Report of the Diseases of London; Dr A. Fothergill on the Abuse of Spirituous Liquors; Junius's Character of Drunkards. (a)

DRUSES, or Denovo, the name of a free and warlike tribe, who inhabit Mount Libanus. They attracted the attention of Europe about the end of the 16th century, in consequence of the visit of one of their princes to Italy. At this time there was much speculation concerning their origin, the meaning and derivation of their name, and the nature of their religion; the prevalent, but unfounded, opinion being that, as they professed a species of Christianity, they were the descendants of the Crusaders; and the similarity of their name to that of Dreux, in France, gave rise to the system of a pretended colony of French, who, under a Count de Dreux, had established a colony near Mount Libanus. At length M. Mitchell, Dragoman of France, at Saide, of which place he was a native, discovered the real derivation of the name of Druses; it takes its origin from the founder of the sect of Mohammed Ben Ismael, who was surnamed El Dorzis; but it is to Messrs Volney and Niehrler that we are indebted for the history of this tribe, and an account of their government, religion, manners, &c.

That they were not the descendants of the Crusaders, is evident from the circumstance that they are mentioned in the Itinerary of Bergamum of Tudelas, who travelled long before the time of the Crusades; their origin, indeed, goes back as far as the end of the 10th century. At this period Hachem, the third of the Fatimite caliphs, sat on the throne of Egypt: his reign was a wild mixture of vice and folly; at last he carried his madness so far as to wish to pass for God himself. In this impious pretension he was supported by an impostor, named Mohammed Ben Ismael, who came from Egypt. Their reign, however, was short, the false prophet being slain in a tumult, almost in the arms of the caliph, and the latter being assassinated by the emissaries of his sister. The proselytes whom they had made took refuge in the mountain of Libanus, and soon formed a independent society. The Turks, for a long time, paid no attention to this new state, either overlooking it by reason of its insignificance, or being occupied with affairs of greater moment. The Druses, emboldened by this inattention, frequently came down from the mountains, and fell on the neighbouring country. At length, in 1588, the Sultan Amurath III. finding that his pachas in vain endeavoured to repress their outrages, resolved to reduce them; and his general, Ibrahim Pacha, completely succeeded. On their conquest, he changed their constitution, allowing them only one chief, instead of a multitude of Shaiks, or lords. This measure, however, rendered them,
D R U

Druses.

in fact, more formidable to the Turks in future, since it placed the whole power of the tribe in the hands of one man; their hostilities, indeed, were secret, but they were carried on with great activity, and generally with success. Their power was at its greatest height about the beginning of the 17th century. At this time Emir Fakereideh, commonly called Fakarideh, was their chief. He ingratiated himself into the confidence and favour of the Turkish government, by making war upon the Arabs, who infested the plain of Balbec. Of this district, as well as of several adjoining districts, he made himself master, till at length the Turkish government began to be alarmed at his rapid and extensive progress, and made preparations to crush him; he did not, however, think it prudent to await the attack; but having previously formed connections in Italy, he resolved to go thither himself, either for the purpose of refuge till the storm was over, or in the hopes of gaining assistance, which might enable him to repel it. It was at this period that the hypothesis concerning the origin of the Druses from the Crusaders took its rise; and Fakarideh finding it favourable to his hospitable reception in Italy, rather countenanced it. After a stay of nine years in this country, the Turks having been repulsed by his son Ali, he returned to resume his government; but attempting to introduce the luxuries of Europe, the Druses became dissatisfied; the Turks invaded the country, to whom in a short time he was betrayed and delivered up; he was carried to Constantinople, and strangled about the year 1631. Nothing important occurs in their history from this time till the year 1770, when they suffered considerably in consequence of having been prevailed upon to take part in the war between Ali Bey and the Emir Yousef.

The great majority of the Druses have in fact no religion, being equally indifferent to Christianity and Mahometanism. They do not consider it necessary to fast or pray, to practice circumcision, or to make the pilgrimage to Mecca. They eat pork, drink wine, and consider marriage between brothers and sisters as lawful. But there is one class of men who profess very singular religious opinions, and whose religious customs are very peculiar. There are various orders of this class: the highest requires celibacy. They consider themselves so pre-eminently pure, that if one of their order eat off their plate, or drink out of their cup, they break them. On this account, vessels with a kind of coo, which may be drank out of without touching them with the lips, are very common among the Druses. They have some sacred books, filled with mystic jargon, but which also treat of another life, and describe several degrees of perfection to which they are to arrive by successive trials. The whole tribe of the Druses are divided into two classes, the common people, and the Shaiks or the descendants of princes: all cultivate the land. The common produce is the mulberry and vine; in some places, tobacco, cotton, and grain are grown. When their crop of silk is over in Lebanon, a great many of them leave the mountains, and go into the plains to assist in getting in the harvest. Their chief, called Haksam, possesses both the highest civil and military powers. The dignity is transmitted either from father to son, or from one brother to another. On failure of the male line, the government devolves on him who, to the greatest number of suffrages, can add the protection or approbation of the Turks. The Pacha is paid a certain portion of the tributes; the rest belongs to the Hachem. This tribute is imposed on the different productions of the country: the shawks and emirs are not exempted from it. No troops are kept, either by the chief or the emirs. When hostilities commence, every person is called upon to march: he brings along with him a bag of flour, a musket, some bullets, and powder. Such an army cannot be formidable; they are all on foot, except the shawks and emirs: cavalry, however, from the nature of the country, are of little service. The number of men able to bear arms is about 40,000, which supposes a population of 120,000; and as the whole country contains only 110 square leagues, there must be 1090 persons on every league. This excessive population is supposed to arise from the freedom which they enjoy, their great frugality, and the emigration of Christian families from the Turkish provinces. The character of the Druses is elevated, energetic, and active; their activity, indeed, partakes of restlessness; and they are brave, even to temerity. These features in their character evidently proceed from their enjoying a considerable share of civil and personal freedom, and from the comparison which they naturally and proudly make between their own condition and that of their neighbours. Like most barbarous nations that are bold and daring, they are strongly averse to the forgiveness of injuries; no people are more nice with respect to the point of honour, or the sense of insult: hence, in their manners, they are scrupulously attentive, and even polite to a degree not usual among peasants. Their notions of the obligation and extent of hospitality are as delicate; every supplicant or passenger is entertained with lodging and food; and when they have once contracted with their guest the sacred engagement of bread and salt, nothing can induce or compel them to violate it. They are permitted by their laws, their religion, or the custom of their nation, to marry several wives; but of this permission few avail themselves, except the emirs. They live in general a very retired life, the men cultivating their lands, and the women making the bread, roasting the coffee, and performing all domestic duties. In the evening, the men usually assemble either in the house or area of the chief of the village or family; where, seated in a circle, with their legs crossed, pipes in their mouths, and pintards in their belts, they converse about their respective labours and employments, the amount of taxes, the conduct of the emir, &c. &c. The only education, (if education it can be called), which their children receive, is derived from listening to these evening discourses of their fathers; they are never taught to read. The language of the Druses is very pure Arabic. See Niebuhr's Voyages, tom. ii. p. 351-7; Volney's Travels, tom. ii. chap. 21. (w. s.)


D Y R A S, a genus of plants of the class Ic sandria, and order Polygynia. See Botany, p. 328.

D R Y D E N, John, the Poet, was born in the parish of Old Winkle, All Saints, on or about the 9th of August 1632. His family had been distinguished for puritanism, and his father had acted as a justice of peace during the usurpation. Our poet is supposed to have received the rudiments of his education at Tichmarsh, and was admitted a king's scholar at Westminster under the tuition of the celebrated Dr Busby. Having obtained a Westminster scholarship, he was
admitted of King's College, Cambridge, on the 11th of May 1650, and after three years standing, took the degree of bachelor of arts, but never rose to that of master. From the university he was called away for a time by his father's death in 1654, to take possession of his inheritance, consisting of two-thirds of a small estate near Blakesley in Northamptonshire, worth in all about sixty pounds a year. The other third part of the small property was bequeathed to his mother during her life, and reverted to Dryden at her death. After his leaving the university, his first patrons were his kinsmen, Sir Gilbert Pickering and Sir John Dryden, both zealous puritans, and adherents of the commonwealth—and, consistently with this patronage, he wrote his Elegy on the Death of the Protector. But at the restoration, being now in his 30th year, without an adequate provision or regular profession, and without the smallest hopes of any promotion, by the aid of his puritanical friends, he seems to have lost no time in adapting his praises and principles to the changed aspect of affairs. He accordingly testified his joy at the restoration of Charles, by his poem, entitled "Astrea Redux," and added another, entitled, "A Panegyric on his Sacred Majesty." At this commencement of his literary career, he was connected and probably lodged with Herringman the bookseller, near the New Exchange, and wrote prefaces and occasional pieces for him. Neither panegyrics nor occasional verses were, however, adequate resources for one who had now to subsist principally by his pen; and as the restoration had thrown open the long shut theatres, he betook himself to writing for the stage. His first piece, "The Wild Gallant," a comedy, came out in 1663, without success. In 1664, he brought out the "Rival Ladies," which was more fortunate, and he prefixed to it his "Essay on Dramatic Rhyme;" and, in the same year, he joined with Sir Robert Howard in "The Indian Queen," to which there is all reason to suppose that he contributed the most poetical part of the verses. The poet's connexion and friendship with Sir Robert Howard, introduced him to the family of the Earl of Berkshire, father to his friend; and in the course of this intimacy, having gained the affections of the Lady Elizabeth Howard, the Earl's eldest daughter, he soon afterwards married her. "The Indian Queen," having been succeeded by "Achitophel," was succeeded in the same year by his "Indian Emperor," which had a still more favourable reception. For some months after the dreadful fire in London in 1666, the theatres were shut, and he appears to have employed his leisure in producing his "Amo Minamitabils," which was published the following year; the first poem not dramatic in which the power of his imagination came considerably forth. Nearly coeval with this was his prose Essay on Dramatic Poetry, in which he vindicates the drama as the highest species of poetry, and rhyme as the most becoming dress in which it can be arrayed. The essay is conducted in the form of a dialogue, in which Crites, the champion of blank verse, was meant to designate his brother-in-law, Sir Robert Howard. The cause of rhyming plays, Dryden had already espoused in his introduction to the "Rival Ladies." Sir Robert had made a direct answer to those arguments, and Dryden, in his dramatic essay, retaliates with some severity. The other restated his opinion in the preface to one of his plays, called "The Duke of Lerna," published in 1668, and Dryden retorted in a defence of the Essay on Dramatic Poetry. The acrimony produced by this dispute between the poet and the baronet, certainly occasioned a breach of their personal friendship; but the quarrel fortunately did not prove irreconcilable. Confiding in the fertility of his pen, our poet now undertook to write, for the king's theatre, no less than three plays in the course of the year. In consideration of this engagement, he was admitted to hold one share and a quarter in the profits of the house, which was stated by the managers to have produced him three or four hundred pounds communis annis. He seems, however, to have felt himself, as we might well expect, incapable of performing the task he had undertaken, for the average number of his pieces did not exceed one half of that number. The players, however, though they complained of his dawdling, were still anxious to retain him.

In the year 1667, was represented his "Maiden Queen," a tragi-comedy, which was so far favoured by Charles II. that he gave it the title of his play. It was followed (in 1668) by "The Tenacest," an alteration from Shakespeare's play of the same name, in which he co-operated with Sir William Davenant. His next play, "Sir Martin Marall," which was originally a translation, by the Duke of Newcastle, from Molière's "Etourdi," was brought on the stage for his own benefit, and, aided by the excellent performance of the comedian Nokes, was played thirty times at the theatre in Lincoln's Inn. "An Evening's Love, or the Mock Astrologer," was his next composition: it is an imitation of "Le Feint Astrologue" of Thomas Corneille, a piece levelled at the prevailing folly of belief in astrology—a belief, however, from which the mind of Dryden was not itself exempt. "The Royal Martyr," was acted in 1668, and printed in 1670. It is in every respect an heroic tragedy, and had a large share of the applause with which those pieces were then received. It was at this period, also, that he produced his first and second parts of his "Conquest of Granada," written, says Dr. Johnson, with a seeming determination to glut the public with dramatic wonders—to exhibit, in its highest elevation, a theatrical meteor of incredible love and impossible valour, and to leave no room for a weaker flight to the extravagance of postscript. They were acted in 1669 and 1670 with unbounded applause. While Dryden was thus generally known for poetry, the advancement of his fortune bore no equal progress to the splendour of his literary fame. Something, however, was done to assist it. The office of royal historiographer had become vacant in 1666, by the decease of James Howell; and, in 1668, the death of Davenant opened the situation of poet laureat. These two offices, with a salary of £200 paid quarterly, and the annual butt of Canary, were conferred upon Dryden on the 18th of August 1676; the grant bearing a retrospect of two years to the demise of Davenant. Dryden was now in the zenith of his reputation as a writer of rhyming, or what was called heroic tragedy. Good taste ought to have been the first antagonist of this bombastic species of poetry; but it was reserved for the second rate talents of mimickry and parody to turn it into contempt. Villiers, Duke of Buckingham, in conjunction with other wits, wrote, in 1671, the celebrated burlesque drama, entitled the "Rehearsal," of which Dryden, under the title of Bayes, was made the hero. Dryden did not answer the "Rehearsal," but he took a subsequent vengeance on Buckingham, when, in "Absalom and Achitophel," he delineated the character of Zimri. His "Marriage a la Mode," a comedy,
Dryden appeared in 1675, dedicated to the Earl of Rochester, whom he acknowledges not only as the defender of his poetry, but the promoter of his fortune. This was the same infamous Rochester, who, on supposing Dryden to be the author of a satire really written by Lord Mulgrave, was base enough to hire ruffians, to way lay and beat him with bludgeons. His play of "Assignation, or Love in a Nunnery," bears the same date with publication, and was driven off the stage. "Ambysonia," a tissue of verse and prose dialogue, written to influence the nation against the Dutch, was not worthy of a better fate. Without entering individually on the notice of all his plays, we shall only remark, that, in 1675, "Aureng Zebe" was the last of his rhyming ones. Experience, and the study of Shakespeare, had taught him, even during the composition of his pieces, that the fierce passions of the stage were unfit for the fetters of rhyme,—an appendage as inappropriate to the theatrical poetry, that would develop strong, simple, and naked nature, as a load of close and ornate drapery to the sculpture of the human form. Still he had hopes of employing rhyme in a province of poetry, where he conceived that he could use it, with all its splendour. He projected an epic poem on the subject, either of Arthur, or the Black Prince, and besought his patron Mulgrave to use his influence with his Majesty, that he might be insured of subsistence while he should compose it. Mulgrave gave the poet an opportunity of conversing on the project with Charles; but from the king he had only fair words. The court, however, required a literary champion to oppose the popular strength of Monmouth and the Whigs, through the medium of the press; and Dryden was selected as laurent, to fight the battles of Toryism with keenest, though lighter, weapons than epic poetry. For this purpose, came forth his "Absalom and Achitophel," a satire not new indeed in its plan of scripture parallel, but in strength and fineness of execution altogether unprecedented. The joy of the Whigs on the acquittal of Shaftesbury, was said to be suggested by Charles himself, as the subject of his next satire, which took its name from the medal worn by the opposers of court politics on that occasion. Among the host of inferior rhymers who answered the medal with abundant abuse of Dryden, Og and Doeg, or Shadwell and Settle, received a ridiculous immortality from his castigation; the former, in Macfleuenoe, the prototype of the Dunciad; the latter, in the second part of "Absalom and Achitophel." These were followed, in 1689, by his Religio Laici, a poetical defence of the English church against the sectaries. It has been urged, with some appearance of reason, by those who have accounted for Dryden's subsequent change to the Roman Catholic faith, on the score of principle, that he wrote the Religio Laici in a state of scepticism concerning revealed religion; not of hard and confirmed scepticism, but of that gentler sort which is accompanied with such a willingness to believe, as extrinsic circumstances might afterwards lead to the opposite extreme of credulity. It is well when scepticism can be thus cured; but the idea of Dryden sitting down half a sceptic to convert others, places him in no very venerable light as a teacher of religion. The drama of "the Duke of Guise," written in conjunction with Lee, in which a parallel was plainly exhibited between the Leaguers of France and the party of Monmouth, was another favour which he conferred on the ruling powers. About the same time, the king's express command engaged him in translating Maimburg's History of the League, the dedication of which to Charles is allowed to savour strongly of political ferocity. The king is exhorted to lay aside his forgiving disposition, and to treat the conspirators as Hereules dealt with Antaeus—"they must be hoisted from their mother earth, and strangled in the air." This pious exhortation was given after the reign of Charles had filled Scotland with tortures and legal massacres; after he had trampled on the liberties of England, and robbed her cities of their charters, at the time when Jeffries polluted the bench; and in the year (1683,) that Algernon Sidney died on the scaffold. It is much to be hoped that Dryden approached his political tasks with a little of that scepticism which is supposed to have attended his first religious lucubration. For all these services, it appears that he received only one donation of 100 broad pieces; and a deplorable memorial of his poverty still remains in one of his letters to Hyde, Earl of Rochester, imploring in vain for some permanent subsistence; deplorable we may call such a memorial, for the effects of his subserviency to bad principles passed away with the cause which he supported, while the benefits which he conferred on literature still remain. Under the following reign he became a Roman Catholic. King James added L.100 to his pension, and Dryden was stigmatized as a hired convert. It is enough, however, to tax his memory with the flattery of a base and bigotted court in the proof of his own degrading dedications, without pronouncing on the inmost secrets of the human heart, and assuming the insincerity of motives which could be known only to himself. It is hardly charitable to suspect motives which malignity itself can only call suspicious. The most important poetry, out of the limits of the drama, which he wrote under King James's auspices, was "The Hind and the Panther." His pen was more unprofitably engaged in a prose apology for the conversion of the Duchess of York to Catholicism; and in translating the life of Francis Xavier, one of the last saints of the Roman calendar. Believing, as he did, in astrology, there was nothing in the wildest of Popish legends which his strong imagination might not be able to digest. The Revolution soon after blasted all his projects; placed the laurel on the head of his enemy Shadwell; and, in spite of the kindness of Dorset, who, when obliged to deprive him of his office, made him munificent presents, obliged him to resume his theatrical labours as an immediate resource. During the reign of King James, he had contributed to a miscellany published by Tomson, some of those translations from Virgil, Lucretius, and Horace, to which Garth has applied the eulogy formerly paid to D'Aubignier, that it was uncertain whether the deed or the living owed him the greater obligation. There is more quaintness than truth in this assertion. The living are positively indebted to him for a fine poem in the English Eneid; but from Virgil's obligation to him, we must deduce all the beauties of the original, which are lost or diminished in their translated form. After the Revolution, he contributed to the materials of two other miscellanies published by Tomson, in concern with his two sons, and other inferior assistants; and being now retired from the stage, bent his thoughts to the great task of translating Virgil. He wrote the first lines of this performance with a diamond on a pane of glass in one of the windows of Chesterton House in Huntingdonshire, the residence of his kinsmen John Dryden; but the antiquary may now search in vain for that frail memorial, for the house of Ches-
tation was, in 1807, pulled down for the sake of its materials. His probable profits from the work have been calculated at £1,300. His last work was the miscellaneous of 1700; which took its name from its most important contents, the Fables. At this period, on the verge of 70 years of age, he had bargained with Tonson to furnish 10,000 verses for 250 guineas; but he received from the Duke of Ormond, for the dedication, £1,500.

Amidst the warfare of criticism, and the toils of literature, his age was now afflicted by the gout and gravel. He had also an erysipelas in his leg, and a neglected inflammation in one of his toes speedily turned to gangrene. He refused to undergo amputation of the limb, telling the surgeon that he cared not to lose it, for the sake of protracting an uncomfortable life to the other members, and closed his existence on the first of May 1700. Dr Garth pronounced a funeral oration in Latin over his grave.

The merits of Dryden are so strong and diversified, that they collectively rank him as one of the greatest of our poets; and yet the destiny of his laborious life prevented him from accomplishing any one production, which can be pronounced at once excellent, extensive, and original. Not one of his dramatic pieces is a master-piece, though many of them bear tokens of the hand of a master. He never reached in the drama to an original conception of character; and he had no talent for pathos, an indispensible qualification in dramatic writing. The design of his allegory the " Hind and Panther," is preposterous. In his Fables from Chaucer and Boccacio, he has only filled up the outline of early masters; his merit in those pieces reaches only to colouring and expression, not to design or invention. In his " Absalom and Achitophel," his plan of scripture parallel was not original; and the story of the poem is necessarily meagre and defective. As an ode writer, however, it would be only repeating proverbial praise to speak of his "Alexander's Feast," and not only from that, but from innumerable instances of his magnificent imagination, not a doubt can remain, that he was equal to the conception, as well as conduct, of extensive and original creations in poetry. The whole history of his life anticipates an answer to the question, why did he not execute such a work? The readiness of his pen was indeed taxed to the utmost; but it is evident, from his constant recourse in narrative to the materials which he could borrow or translate, that he despaired of having leisure to invent. At the same time, his power of managing stories at second hand, his touches of addition and renovation, and the air and spirit with which he personates the character of an original narrator, is so like originality itself, that we forget all his debt of the materials to another, and regard the facts, the contrivance of incident, and whatever had been left to him by a predecessor, as only fortuitous advantages, which none other could have used; or like the strings of some instrument of music, which no other hand could have readjusted and taught to produce the notes of enchantment. This remark on his art of renovating poetical narrative, we conceive to be peculiarly applicable to his imitations of Boccacio and Chaucer. His translation of Virgil cannot be considered, without a comparison with the original, more favourable to the English poet. The circumstance which leaves the deepest impression of his genius, is his portraiture of moral character. As a story, "Absalom and Achitophel" has neither interest nor regularity, but it is a great gallery of historical portraits,—sketched with the very science of moral physiognomy, taken from life, and full of the spirit and air of vitality, and touched with a singular union of gay satire, and of dignified intellectual energy. The polemic may be wrong, but as a polemical poet, Dryden has always the art to make his fancy potently illustrative of his reasoning; and his reasoning has, for all the views of poetry, both a bold and familiar aspect of command. With majestic numbers, he seldom or ever reaches to the sublime; his manner, for ever recurring to carelessness and flatness, has not an ethereal or supported tone of inspiration, but it always assumes an eloquence (keeping apart his bad tragedies,) in which the judgment is mainly, and the imagination profuse, and the force and fidelity of language at once preserved and heightened by the noblest structure of English rhyme. (‡)

DRYMOPIIILA, a genus of plants of the class Hexandria, and order Monogyna. See Brown's Prodrumus Plant. Nov. Holl. &c. p. 292; and Botany, p. 196.

DYPYIS, a genus of plants of the class Hexandria, and order Trigynia. See Botany, p. 167.

DSCHOUFUFTKALE, or Duchufutkal, is a town and fortress in the Crimea, built on the summit of a mount, which rises into a peak on each side. The town contains about 200 houses, and about 1200 inhabitants, who are principally Karaite Jews. The chief part of each house is occupied by the women, but the master has his own private apartment, where he smokes, sleeps, and receives his friends. The principal objects of interest in this place are the remains of a stately mausoleum, erected for the daughter of one of the khans of the Tartars, and the cemetery, or "Field of Dead," belonging to the Karaite Jews. This cemetery, situated at the beginning of a valley, and without the town, is a beautiful grove, filling a chasm of the mountains, and solemnly shaded with lofty trees and impending rocks. There are ranges of tombs in the form of sarcophagi, and the tombs bear Hebrew inscriptions, the most ancient of which is 338 years old. On one of the oldest was the following inscription:

CECY — JOSPEH, FILS DE SCHIBAHTAI
LE TONBEAU — 5204,

a date which corresponds with the year 1445 of our era. As there is no water in the town, the inhabitants are obliged to convey it on the backs of asses from a spring in the defile, and deposit it in a reservoir cut in the rocks.

The inhabitants of this town keep their shops at Batcherseri: they go there on horseback in the morning, and return home in the same manner in the evening.

See Reuilly's Travels in the Crimea in the year 1803, chap. vi.; and Dr Clarke's Travels, vol. i. p. 479. See also Batcherseri. (‡)

DUBLIN, a county of Ireland. It is situated in the province of Leinster, and is bounded on the east by the Irish sea; on the north, by East Meath; on the west, by East Meath and Kildare; and, on the south by Wicklow.

This county is not remarkable for its scenery. In aspect general, it is flat and uninteresting. On the sea-coast, however, where there are many bays and creeks, it affords some picturesque views. And the prospect across the Bay of Dublin, towards the south, is extremely grand and magnificent. Approaching to Wicklow, there
is a continued series of gentlemen's seats, which are laid out and adorned with much taste. On the borders, it has all the rocky and mountainous features of that county. In general, the soil is very cold and unfruitful. In some parts, the subsoil is so calcareous, that it effercesces when exposed to the action of an acid. The climate is warmer than might be expected. In the five years ending 1800, the medium atmospheric heat was 50° 15'; the maximum being 81° 50', and the minimum 14° 50'. The range of the thermometer is about 36°; that of the barometer about 27.5 or 2.4 inches. The average quantity of rain that fell at the botanic garden near the city of Dublin, for the 10 years ending 1811, was 22,988 inches. The south-west wind is the most predominant. The south-east is the most pro-

flice in rain.

Agriculture is not in a remarkably flourishing state. The system pursued is an unskilful one; and of course the quantity of produce is unequal to the advantages enjoyed. The grain, however, is generally good in quality. Very little wheat is raised. barley is seldom sown. Oats and potatoes are standard crops. There is almost no flax cultivated. In 1608, about 45 acres were under hemp.

The following is an average view of the quantities of seed used, and of the produce per English acre. This table is made from the statements of Mr Wakefield; but from the produce assigned to oats and potatoes, we suspect his statements are, not incorrect, so far as they go, but of insufficient extent and variety to afford a fair average.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Seed used per English acre in lbs. aver. dupas.</th>
<th>Produce per English acre in lbs. aver. dupas.</th>
<th>Proportion between seed and produce.</th>
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</thead>
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<tr>
<td>Wheat</td>
<td>240</td>
<td>2100</td>
<td>1 to 8.75</td>
</tr>
<tr>
<td>Barley</td>
<td>224</td>
<td>2352</td>
<td>1 to 10.5</td>
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<tr>
<td>Oats</td>
<td>441</td>
<td>4018</td>
<td>1 to 4.5</td>
</tr>
<tr>
<td>Potatoes</td>
<td>3800</td>
<td>18,801</td>
<td>1 to 4.9</td>
</tr>
</tbody>
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The breeds of cattle in this county are multifarious. Every different kind almost is to be found here that is to be found in the island. But little attention is paid to the improvement of them. In the city of Dublin and its neighbourhood, there is a vast number of cows kept for the dairy. They are chiefly of the English and Dutch sorts. Their average produce of milk in summer is eight quarts, and in winter five quarts per day. They sell at from 10 to 20 guineas each. In this county the farmers have no flocks of sheep.

The fuel made use of is furze, turf, and coal import-

ed from the west of England. A good many trees are to be seen around gentlemen's seats, but wood is not abundant. The weeping, or Hertfordshire elm, is frequently raised.

The weights and measures of this county are various. In the district of Fingal, 5 stone is equal to a bushel of wheat; 4 stone = do. of barley; 3½ stone = do. of oats; 5 stone = do. of potatoes; 4 stone = do. vetches. In the city of Dublin, 20 stone is equal to a barrel of wheat; 16 stone = do. of barley; 14 stone = do. of oats; 20 stone = do. potatoes; 8 barrels = 1 ton of coals; a kish of turf = ¾ feet by 2, and 3 feet deep; a perch = 21 feet in length, and 8 feet in width; a barrel of roach lime = 40 gallons of 217¾ cubic inches; a stone of rough tallow = 15 lbs. The common lawful

English weights and the Winchester bushel are also in use. Hay, garden, and flax seed, are sown by the bushel.

In some places labour is paid in money, and in other places in money with conveniences, such as a cottage, labour, &c. The following is a list of prices for the year 1811. A man the year round L. 23; 8; a woman do. L. 15; 12; carpenter per day 3s. 10d.; mason do. 3s. 8d.; slater do. 4s. 3½d.; quarryman 2s.; thresher do. 2s.; mason per 21 feet 1s. 1d.; slater per square 2l.; bricklayer per perch 2s. 2d.; cart and horse per day 3s. 4½d.; grazing a cow per week 3s. 9½d.; do a horse do. 7s. 3½d.; fencing per perch, ditch 7 feet by 6, 4s. 4d.; sea coal per barrel 8s. 4½d.; culm per ton 3s. 3½d.; furze per thousand 8l. 10s.; bricks per thousand 2l.; lime per barrel 1s.; plough timber 1l. 2s. 9d.; a car mounted 4l. 1s. 1d.; bran per barrel 6s.; potatoes per stone 6d.; salt butter per cwt. 5l.; fresh do. per lb. 1s. 4d.; hay per ton 4l. 1s.; whisky per gal-

ton 9s.; ale per quart 3d.; porter per gallon 1s. 2d.; beef per lb. 7d.; mutton do. 6d.; veal do. 10d.; pork do. 4d.; lambs per score 10½l.; eggs do. 10½l.; cheese per lb. 1½d.; bacon do. 1st.; shoeing a horse 3s. 6d.; brogues per pair 7s.; shoes do. 9s.; leather per lb. 1s.; salt per stone 1s.; a spade 4½d.; shovel 2s. 6d.; Swedish iron per cwt. 1l. 10s.; wool per stone 1s. 6½d.; fowls per couple 4s.; turkey 2s. 6d.; goose 1s. 7½d.; wheat per barrel 2l.; barley do. 2l.; oats do. 1½s.; malt do. 2s. 5s. 6d.; flour, 1st per cwt. 2l. 12s. 2d. do. 1l. 18s. 3d. do. 1l. 6s.; oatmeal per stone 3s.; harvest of hay or corn per day 2s. 5d.; day labour of children 7d.; mowing grass per acre 8s. 8½d.; rabbits per couple 1s. 10d.; milk per quart 2½d.; Rush ling per cwt. 1l. 1½s.; corn acre of meadow 7l. 10s.; do. of potato land 10l.

Among the largest land proprietors in this county are Mr White, Mr Hamilton, Mr Talbot, Lord Long-

ford, Lord De Vesci, and Lord Mountjoy. None of the estates are very extensive, which circumstance is probably owing to the neighborhood of a great commercial city. The size of farms varies very much. Leases also are of various terms, except that they generally in-

clude a life, in order to command a vote. The land, from its proximity to the capital, is a more marketable commodity here than in most other counties of Ireland. The rental must be high, not however from the quality of the soil, but from the number of acres attached to villas and country seats, and other local advantages. Mr Wakefield makes its average over the whole county to be not less than L.3 per acre. The whole rental at this rate would be about L.426,130 in Irish estimate, both of land and money.

The only river of consequence is the Liffey. It rises in the county of Wicklow, runs west into that of Kil-
dare, then turning north-east intersects the county of &c. Dublin, passes through the city, and a little below falls into the Irish sea. From the Liffey a canal has been made, which joins the Shannon at Clonmel. There are a good many bays and creeks. That of Dublin is very beautiful. The principal harbours are those of Dublin, Rush, Skerries, and Balbriggan.

In this county there is manufactured a strong kind of 7-8th dowlas, and also some 9-8th and 5-8th sheet-tures. Goods of this sort are sold in the Drogheda market, and find their way in an unfinished state into the country markets of England.

On the Liffey there is a considerable salmon fishery, belonging to Sir W. Worthington, extending from Is. fisher's land-bridge to the light-house at Polebeg. It employs
about eighteen or twenty men. From the beginning of January to the end of September, it yields from 90 to 200 fish every week, which sell, on an average, at about 17s. each. This county is distinguished by the goodness of its cels: They are found in great abundance in Tullaghreen river, and in the neighbourhood of Fieldston. The quality of these is excellent. They are called silver cels, on account of a remarkably white and clear colour, which they are supposed to derive from the superior purity of the water, which runs over a bed either of sand or gravel. The mud-cels are yellow bellied, and of a less pleasant flavour. Sand-cels are found in great plenty along the coast, and furnish an agreeable and wholesome supply to the necessities of the poor. The number of herrings for fishing at sea, belonging to the county in 1801, was 87, carrying each seven or eight men, and employed, in the proper season, in catching cod, ling, haddock, ray, herrings, &c. They receive a parliamentary bounty of 20s. per ton; but it is complained, that this bounty is become too small, on account of the increased expense of the coasts used in the occupation. Besides these, there are about twenty smacks and five seine nets occupied in the salmon fishery, between Dublin-bay and Dunleary. At Dunleary there are also eleven yaws, and at Bulloch seven, which fish for whiting, pollock, and herrings. At lusk and Skerries, the art of curing the cod and ling has been carried to very considerable perfection. The cod and ling cured at these places are reckoned preferable to the foreign fish. The sturgeon has sometimes appeared in the bay of Dublin. In September 1746, one was caught between that place and the Isle of Man, which measured six feet long, and three broad in the thickest part. The sprat is found in the Liffey, between Dublin and Island-bridge, and in several other places. Good lobsters are found at Howth and Lambay. Lobsters and crabs are also brought from Galway and Wexford, and fattened in coops at Bulloch. There are two artificial, but not very productive beds of oysters, one opposite to Cold Harbour, and the other near Sutton. They were transplanted from Arklow. The oysters were injured by being taken up too soon, to answer the great demand. Several natural beds are mentioned by Dr Rutty. In one of these, which was situated east-north-east from Ireland's Eye, and lay at the depth of eighteen or twenty fathoms, the oysters were so large as to be of the size of a horse shoe. Porpoises are frequent on the Dublin coast.

The minerals found in this county are marl; sand fit for all uses; limestone; excellent granite, which is so abundant as to have in some measure supplanted the Portland stone; good freestone; lapis Hibernicus, or Irish slate, of which there are large rocks on the coast between Rush and Skerries, that in some places exhibit a vitriolic efflorescence: copper and lead, of both which there were mines formerly wrought at Lough Shinney and Old John Bar; ochres of different colours; potter's clay; beautiful pebbles; porphyry, and crystals. On this part of the subject the reader may consult Stephens' Notes on the Mineralogy of Part of the Vicinity of Dublin. In several places there are mineral waters. Of these, a full and accurate account is given by Dr Rutty in his Natural History of Dublin. The village of Lucan, situated towards the south, and of great beauty, is celebrated for its spa, which resembles that of Aix-la-Chapelle and Bruges, with this exception, that its waters are cold.

Formerly Dublin sent ten representatives to the Irish Parliament. It now sends five members to the Imperial Parliament; two for the county, two for the city, and one for the university. The freeholders of the county are very numerous, and very opulent, and therefore not subject to political influence in the choice of their representatives. It comprises, exclusive of the city and liberties, six baronies, viz. Belruidery, Nethercross, Carlock, and Castleknock, on the north side of the Liffey; and Newcastle and Half Halfathawn on the south. There are 107 parishes, 20 of which are in the city. There are two regiments of militia, one for the city and one for the county. Four grand juries are impannelled every year, in each quarter. Two of these are presenting juries.

Dublin is one of the four ecclesiastical provinces into which Ireland is divided, and comprehends five sees under four prelates. The see of Dublin, of which the first mention we find is in the 7th century, embraces the whole of the county, the most of Wicklow, and part of three others. It was erected into an arch-bishopric in the year 1132. In 1214, the bishopric of Glandalough, founded in the 6th century, was incorporated with that of Dublin, and constituted a church. Patrick, Dublin, consists of the dean, the precentor, chan-}

Ecclesiasticall division.

ceillo, treasurer, the archdeacon of Dublin and Glandalough, and nineteen prebendaries. The members of the collegiate chapter of Christ Church, are the dean, precentor, chancellor, treasurer, archdeacon of Dublin, and three prebendaries. The archbishop's revenue was estimated by Mr Young, in 1779, at L 5,000, and lately by Mr Wakefield at L 12,000. Of those round towers, which are so frequent in Ireland, and which, from their being always near a church, are supposed to have been erected for some religious purpose, there are four in this county. One at Clondalkin, one at Lusk, one at Rathmichael, and one at Swords. There was one in Ship Street, Dublin, which was destroyed about thirty years ago.

The length of this county, from north to south, between Meath and the sea, is 304 English miles; and its breadth, from east to west, about 19. Its area is 355 square miles, or 228,211 acres. It contains 198,000 inhabitants, according to Dr Beaufort's statement in 1792. Of these, 14,600 belong to the city. The other 54,000 inhabit 10,560 houses; thus giving about 5.1 souls and 4.2 acres to each house. There is every reason to believe, however, that the population is greatly increased since Dr Beaufort's estimate was formed. According to the return made in 1791, by the inspec-}

Extents and population.

tor-general of hearth money, there were 25,108 houses; of which 7095 paid for one hearth, 2016 for two, 1293 for three, 1571 for four, 1252 for five, 1950 for six, 2123 for seven, 1930 for eight, 1226 for nine, 834 for ten, 1319 for more than ten and less than 44, 6 for 44 to 114 inclusive; 673 were returned as new, and 1213 exempted on account of pauperism. The proportion of Catholics to Protestants is, in many parishes, ten to one; in some it is above twenty to one; in the parish of Narramore it is forty-two to one; but, on an average, it may be reckoned at six to one. In the county regiment of militia there is scarcely a Catholic officer; but many of the privates are of that persuasion. In one company of 200 men there were only 70 Protestants. In the city regiment there are 470 Catholic privates, but not a Catholic officer, commissioned or non-commissioned. See Beaufort's Memoir of a Map of Ireland; Rutty's Essay towards a Natural History of the County of Dublin; Archer's Survey of the County of Dublin; Dutten's Remarks on Archer's Survey; and Wakefield's Statistical and Political Account of Ireland. (»)
Dublin...

Dublin, the metropolis of that part of the united kingdom called Ireland, is situated in the province of Leinster, nearly in the centre of the eastern coast of the island, on a fine stream, at the west end of a deep bay; and distant eight miles from its opening into the Irish Channel; 60 miles west from Holyhead, in the Island of Anglesea, in Wales; 330 north-west from London. It is situated in North Lat. 53° 2' 2", and West Long.-from Greenwich 6° 15', and is bounded by the county of Dublin.

The bay, at its entrance, is about five miles broad, and gradually opens to the breadth of seven, on the north and south beach. The Hill of Howth, which is a peninsula on the north side of the bay, and the rising grounds of Rochestown on the south, direct the view from the bay to the surrounding country, which gently swells from the north-east to the west for six miles, and to the south-east and south-west rises into lofty mountains, at the distance of twelve miles: the space west of Howth, to the rising ground, is filled by the view of two islands, which have a grand appearance, viz., Ireland's Eye, at the distance of a mile; and Lambay, at the distance of seven miles.

The bay, at the distance of five miles from its entrance, is divided into north and south by a mole and parapet-walls, which extend into the sea 17,734 feet, on the right of the stream of the river, during the ebb. It was begun in 1748, and finished in 1755. This mole, for 7948 feet, is 40 feet wide, and has three wharfs to descend to the strand; and the whole road is five feet above the highest water-mark. The house at this part is called the Block-house; and from this to the Light-house, the road is formed of 9816 feet of large blocks of mountain granite, strongly cemented and cramped with iron: the road is 28 feet wide, sloping to 32 at the bottom; and five feet above the highest water-mark to the Light-house. Vast solid masses of stone were sunk in chests, and afterwards guarded by solid masonry, 85 feet broad at the base; and on this was raised a circular structure of white hewn granite, three stories high, surrounded by an octagon lantern of eight windows, tapering to the top. Each story is strengthened by arch-work: a stone staircase winds round the building to the second story, where an iron gallery surrounds the whole. The lantern is supplied with large oil lamps, and reflecting mirrors. This building, and the wall, afford a certain direction for the navigation of the bay, to the mouth of the river. A line drawn from this, due south, forms the eastern boundary of the city jurisdiction.

The city is divided into north and south by the river Anna Liffey (Swift River), over which there are six bridges: four are built of hewn mountain granite, and part of the piers; the cornice and balustrade are of Portland stone. They are 60 feet wide between the balustrades, and have a raised foot-way on each side, and double rows of globes. The river, in its embankment, is 150 feet wide to the east of Carlisle bridge, and rises thirteen feet at high water: it is 120 feet wide at the western bridge, and rises seven feet. The improvement of the city by quays has been the work of the last century; and at present they are rebuilding, of mountain granite, with walks at the parapets.

The buildings of the city now occupy 1600 acres: from east to west it is two miles and a half long; for a mile from the west it is nearly square; and for the other mile and a half it is from north to south one mile and three quarters. Dublin contains 671 streets, all laid out since 1720. The streets are from 40 to 50 feet wide; those built since 1774, are from 50 to 60 feet wide; and all of them have flagged foot-ways suited to their breadth. In 1610, the walls of the city were built: the circuit did not exceed a mile; and the castle occupied the southern extremity. The city, and adjoining ground, is now surrounded by a road, 60 feet wide, with footways communicating with all the avenues, and distant nearly two miles from the castle: it is kept in excellent repair by a toll. The elevation of that part of the road, which is on the north-west and north-east, affords some most beautiful landscapes. Part of his Majesty's park, the Phoenix, is within this circuit; it is so called, from a Corinthian fluted pillar, 30 feet high, surmounted with a phoenix, erected by the Earl of Chesterfield, the viceroy in 1747. This has been always open for the citizens. There are, in this park, above 700 acres; and in different directions there are enclosures and mansions for the viceroy, the secretaries, rangers, and some grantees. There are also a fine military hospital; a large military school for the children of soldiers, with a beautiful church for them; a salute-battery of twenty-one guns, and a magazine. None of these buildings interfere with the views, or with each other. The park has two fine sheets of water, is well stocked with deer, diversified with copses, woodland, and open grounds, and is without hedges or trenches. It has the view of the river for two miles; above which, at the distance of 30 perches, it rises abruptly about 50 feet; and thus commands a full prospect of the city, the bay, and all the surrounding country. The park is connected with the south side of the river by a bridge on the circular road, of singular beauty: the arch is elliptical, and 104 feet in diameter; and the key-stone is 22 feet above the high water mark. It is 326 feet in length, 38 in breadth, with flagged footways: The base is of white hewn mountain granite; and the piers, cornice, and balustrade, of Portland stone, with two rows of lamps. It is called Sarah-Bridge, out of respect to the memory of the Countess of Westmoreland, who laid the first stone of it in June 1791.

The ground from the river, and four small streams of distant courses which fall into it, rises near them from 24 to 40 feet; so that the buildings of the city are very healthful, and nearly all command a prospect of the surrounding country.

The embankment of the river, from the strand, for 240 perches, between the city and the harbour, on the north side, and on the cast for 360 perches, to the Bay, with solid walls and sluices, was made at the expense of the Corporation. The inclosure was divided into lots, and let to fee-farm, with the burthen of repair and maintenance, under the view and control of the city magistrates, and lately of commissioners, incorporated in 1756. The same was also done on the south side by Sir John Rogerson, by a solid wall and sluice draw-d to the Liffey; and on the east side by a wall and mole of 380 perches to the left of the Dodder, a mountain-river which runs at this point into the Liffey. Over the Dodder there is a commodious bridge, which leads to the south wall. All this embankment is under the care of commissioners.

The houses are built of good brick, and the fronts Buildings are commonly of that finer sort called stock-brick: they are generally five stories high, of which the cellars are one. In the streets laid out by the commissioners incorporated in 1758 and 1774, the houses are generally six stories, and so well built, that they are valued and sold as bearing equal interest for sixty-one years.
In the year 1791, the city contained 22,000 houses, and the inhabitants were estimated at 226,000. Since that period, more than 4000 houses have been built, which, at the same calculation, would amount to 278,000.\* The supply of corn, flesh, fowl, and fish, is very abundant. The fuel is supplied from Scotland and Cumberland, and from the bogs through which the two canals, the Grand and the Royal Canal, run. There is great plenty of turf.

The city is supplied with water on the north side by the Royal Canal, which communicates with a basin handsomely laid out, and provided with branches for its distribution; and, on the south side, the sheet of water is enclosed by a mole and a terrace-walk, neatly planted with a thickset hedge and elms. This reservoir is filled constantly by a stream from the mountains, and from the Grand Canal; the water of the two reservoirs is distributed through the city by double ranges of pipes; a great part of which are new, and all hereafter are to be of metal. Every house pays the water-duty, and is therefore supposed to have a branch from the adjoining main.

The care of the food, fuel, watching, cleansing, lighting, requiring the pavement, the roads, the parapets of the quays, the sewers, the jails, of decayed houses, and of the removal of all nuisances, is divided among the citizens and inhabitants by special acts of Parliament; and these incorporations are empowered to discharge the trust in a very effectual manner, by fine, distress, and imprisonment.

The barracks, situated on an elevated ground at the north-west side of the river, about 30 perches from it, and rising above the adjoining streets 30 feet, were opened in 1794, and are fit to lodge 4000 infantry and 1000 cavalry. They have four large squares, three of which are for the infantry, and one for cavalry; the three to the south occupy a front of sixty perches, and that to the east twelve. Since 1795, barracks have been erected in different parts of the inclosure within the circular road, which can accommodate 10,000 men.

On the opposite side of the river stands Kilmainham Hospital, on a site of 64 acres, a part of the royal park, erected in 1683, at an expense to the army of nearly £4,000. There belong to this establishment resident and out-pensioners; it is quadrangular, with a spacious area in the centre. The chapel and dining-hall occupy the north side; the portraits of the sovereigns decorate the dining-hall, and the centre of this hall is ornamented with a spire and clock. The whole building is four stories high, with an open piazza on the ground and corresponding corridors over the piazza, which renders the communication through the centre very agreeable. The invalids do duty. There is a military road from it to the barrack bridge, to give the commander in chief, whose stately residence is within this part of the park, a speedy communication with the barracks.

The Castle, the town residence of the viceroy, occupies two squares, all rebuilt in the last century, except the south-east tower, called the wardrobe tower: The south-west tower is called Birmingham tower. The entrance is on the north side from Castle Street, by a stately gate, 80 feet high, surmounted with a statue of Justice, which has a correspondent gate-ornament on the same flank, surmounted by a statue of Fortitude, and both connected by a handsome edifice, called Bedford Tower. The front to the court is decorated with an arcade of three arches, over which there is an octagon steeple, with a cupola and clock; the remainder of the building to Castle Street from the Castle gate, is the guard-house, and the whole is enclosed there by a range of iron palisades.

The guard consists of a captain's company of foot, a subaltern's guard of horse, detachments of artillery and of battle-axe guards. These are dresse" in the ancient habit, and do duty near the presence chamber. They are commanded by a captain, who ranks as colonel, and by two subalterns, who rank as captains.

The centre of the ground plan of the lower court is sixteen feet below the upper, being in the course of a mountain river, which formed the foss of the first projection of the castle. In it are the treasury and other state offices, the armoury, and arsenal. The beautiful Gothic building, the chapel, now nearly finished, fills the southern range. The street leading from the city into the court nearly at its centre, and to the western postern, is parallel and close to the south side of the buildings of the two squares, and is closely bounded on the south by the castle garden, to which a passage is opened by a beautiful range of granite stairs, supported by an arch over the street. This part of the buildings of the upper court is called the garden front, erected in 1740. It is finished with white granite, and ornamented with semicolumns of the Ionic order, and the windows are embellished with cornices and architraves.

The approach to the state apartments is in the upper court, by an open vestibule, projecting twelve feet, and sixty feet wide, and forty deep, supported by Doric columns, leading to a staircase twenty feet wide, with two ranges from the first landing. The presence chamber is over this hall; it is a very fine room in all its proportions.

The hall room is appropriated to the festivals and meetings of the knights of the illustrious order of St Patrick, instituted 17th March 1783. His Majesty is the Sovereign, the Lord Lieutenant, for the time being, the Grand Master, and the Knights Companions are 15. They wear a sky-blue watered ribband, with a metal appendant, of two inches diameter, encircled with brilliants. In its centre there is a saluter of an inch diameter: the interstices of the salter are occupied with the motto, "Quis Separabit," in allusion to the decoration of the centre of the salter, which is the shamrock bearing three crowns. The hall was ornamented with historical and allegorical paintings, by the celebrated Mr Waldrie, during the administration of the late Marquis of Buckingham.

In March 1766, the first stone of the courts of justice, on the north side of the river, was laid by his Grace the Duke of Rutland, in the presence of the Judges, on the site of the Dominican convent, which, at the suppression of the monasteries in 1541, had been retained by the crown for a public office, and used to this period as the Rolls Office. The new buildings were finished, and the courts opened there, in November 1796. The whole range extends 436 feet in length, and 50 in depth. The court yards of the offices on each side, are open to the quay, and separated from it by iron palisades and beautiful gateways of hewn

\* According to the estimate of the late Dr Whitelaw, the population in 1798 was only 172,094; but this is admitted to be far below the real population.
DUBLIN.

mountain granite, with side doors. These courts extend 99 feet to the quay, and are 50 deep; between them the front of the hall projects. It is composed of six columns of the Corinthian order: in the centre of these is the principal entrance, with an extensive vestibule. The hall, from which the courts radiate, is circular, and is 64 feet in diameter. The entrance to them from the hall is ornamented with Corinthian pillars and semicolumns; and the stately cupola, of the same diameter, gives bright light to the whole hall, by windows in the sidewalls. Each court has all its suited apartments within itself; and these buildings occupy 235 feet in front, and 50 in depth.

The cupola is ornamented with the busts of the most celebrated legislators, ancient and modern; and the whole building is insulated.

The removal of the courts from the centre of the city, where they were held for a century, caused a great depression in the value of the buildings. To remedy this, there is a Parliamentary grant, in 1807, for the improvement of the city on the south side of the river to the west of the castle. This expenditure, by widening the streets in this part of the city, with the elevation of the ground, will render it most convenient and wholesome.

The Danes settled on the coast were in possession of the lands about Dublin, and of Dublin, during the greater part of the 10th, 11th, and 12th centuries, and kept it, notwithstanding the victory at Clontarf in 1014, till it was taken by Raymond le Gros in 1171. He was the auxiliary of Dermot MacMurrough, Prince of Leinster. It was erected into a bishoprick in 1038, and to an archbishopric in 1132. St Lawrence O'Toole changed the chapter of Christ Church into a priory. Archbishop Comyn, in 1190, erected St Patrick's Church on the site of an old parochial church, and his successor, Henry de Lomard, erected it into a cathedral. During his administration, the diocese of Glendolough was united to it in 1214, by Cardinal Papire, the legate. The present building of St Patrick's was erected in 1535 by Archbishop Moises, and the steeple in seven years after. The present spire was built by Dr Sterne, late Bishop of Clogher, and formerly Dean of St Patrick's. The chapter, nave, and aisles are in very good preservation. The stalls in the choir are adorned with the banners of the arms, the swords, and the helmets of the Knights of St Patrick; and those of the deceased kings are in the Chapter House. The archbishop is the chancellor of the order, and the dean is the register. The monuments in the aisles, and on the left of the altar in the chancel, are very beautiful.

The chapter consists of six dignitaries, twenty prebendaries, four minor canons, and fourteen vicars choral. There is a library belonging to this cathedral, of which we shall afterwards give an account.

Christ Church, the ancient cathedral of Dublin, lost its rank by its change into a priory; and on the dissolution of the monasteries in 1541, it was formed into a collegiate church, with a dean and chapter. At present the Bishop of Kildare, for the time being, is the dean, and there are besides four dignitaries, three prebendaries, six vicars choral, and seven stipendiary chaplains. The ancient building, erected by Archbishop Comyn, in 1190, was burnt in 1293. The present building is kept in good preservation, and the monuments are interesting. The Archdeacon of Dublin has a stall in the choir, and a voice and seat in the chapter. There are besides of the established Church, nineteen churches and twelve chapels; of the Roman Catholic communion, twenty-six chapels; two meeting houses of the Church of Scotland, seven of other Dissenters, four of Methodists, two of Quakers, one Luthern Danish, and one French Calvinist. St Catherine's, St George's, and St Werburgh's, are finished in a fine style; St Thomas's and St Anne's are also well built; but the fronts are left unfinished. St Andrew's is rebuilt in its rotunda form, and decorated in the best manner. All those buildings which do not belong to the established Church have been erected by subscription, and on this account are not of that solid nature which bids defiance to time, or of that external beauty which will attract the attention of a visitor.

There are fifteen parish schools annexed to the established Church, in which 397 children are fully maintained and educated, and afterwards apprenticed. There are also three female orphan houses, under the direction of the established Church.

Every house of worship has also some children under its protection, besides the general and numerous associations for the protection of foundlings and orphans, by private subscriptions, and annual charity sermons. The following institutions, which are incorporated by acts of Parliament, and receive annual grants, are worthy of notice: The Hibernian Society, for the orphans and children of soldiers; the Hibernian Marine Society, for the orphans and children of decayed seamen, in his Majesty's navy; the Blue Coat Hospital, for the children of reduced freemen of Dublin; the Foundling Hospital; the House of Industry; the Incorporated Society for promoting English Protestant schools in Ireland; the Board of Education; and the Association for discomfitting Vice: besides, the Hibernian Bible Society, not yet incorporated.

The hospitals for the reception of sick and wounded, or maimed, are eight; one for lying-in women; one for the blind and gouty; two for lunatics; one for incurables; one for teaching the blind; three for fever; three for female penitents; one for a particular infectious distemper; one to re-establish health after cure, and procure character; one for the cow-pock institution; one cow-pock dispensary for ditto; and five general dispensaries of medicine.

The Societies for relief from poverty, &c. are the Sick and Room Keepers Society; two houses of refuge; the Strangers Friend Society; the Literary Teachers Society; the Incorporated Irish Musical Fund Society; the Charitable Loan Society, for lending out money interest-free to tradesmen; Meath Charitable Loan Society; the Dublin weekly and daily schools; the Sunday and daily schools; the schools of the House of Industry. It is generally estimated that education is given to 9000 poor children.

The university of Dublin was founded by Queen Elizabeth, in 1591; its charter was renewed, and statutes compiled by Archbishop Laud, in 1637. The monastery of All Hallows was dissolved in 1541, and granted to the citizens of Dublin, who regranted it in 1590, for the site of the university. No part of the ancient buildings remains. The present building consists of two squares: the first is modern, and executed from the designs of Sir William Chambers; the front, which looks to the west, is built of Portland stone, and is highly decorated with Corinthian pillars and other ornaments; it is upwards of 340 feet in length; over the vestibule, which is an octagon terminated with groined arches in the centre of this front, is the museum, a fine room sixty by forty feet, furnished with a great variety of curious natural and artificial productions. The area of this
square is 316 by 212 feet, and entirely built of Portland stone, by grants from Parliament to the amount of L. 40,000. It contains on the north side the chapel and dining hall, and on the south the theatre: the front of this is decorated with four Corinthian pillars supporting a pediment; its interior is 98 feet long, including a semicircular recess of 30 feet diameter, 40 broad, and 44 feet high. A rustic basement supports a range of pillars of a composite order, highly decorated, from which the Mosaic ceiling rises in groined arches; and the following pictures are hung between the pilasters: Queen Elizabeth, Primate Usher, Archbishop King, Bishop Berkeley, William Molyneux, Esq. Dr Baldwin, Lord Clare, and the Right Honourable John Foster, Esq. The monument of Dr Baldwin, a former provost, is in this theatre; it is the work of Mr. Hewson, who executed it at Rome: a large sarcophagus of black marble supports a white marble mattress, on which the provost is represented in a recumbent posture, larger than life, with a scroll representing his will, (amounting to L. 80,000, bequeathed to the university,) in his left hand, on the elbow of which he supports himself, and holding his right hand extended open; a female figure, in deep grief, representing the university, leans over him, and he looks up to her with resigned complacency; at his feet there is an angel holding a wreath of palm in his left hand, who points up to heaven as his reward; behind these figures there is a magnificent pyramid of variegated Egyptian porphyry. This successful proof of the taste and ability of their countryman for this important work, does immortal honour to the artist, and to the persons by whom he was selected. He received L. 2000 for it.

The chapel on the north side, and opposite to the theatre, is executed in the same style of architecture. These two buildings advance about twenty-five feet into the square, and form the boundary of the building, erected at the expense of parliament. The dining hall is a detached building on the same side, of Portland stone, with a stately ascent by a range of stairs the whole extent of the portals, 35 feet high, 35 feet wide, and 70 long, with an anti-room 35 feet broad by 30 deep, capable of entertaining 400 persons; and over it is the Historical Society Chamber, of the same dimensions, where students of a certain standing meet to exercise themselves in oratory upon chosen subjects, for excellence in which gold medals are given. The eastern side of this square is of brick, and likewise the entire building of the inner square, excepting the library, which occupies the south side of it. It is built on a piazza, and is of hewn stone, with a magnificent Corinthian entablature, surmounted by a balustrade. The great repository room is 210 feet long, 40 feet high, and 40 broad. The bookcases are in recesses which advance from each window, and are formed by the gallery over them, the balustrade of which is ornamented by the heads of illustrious personages, sculptured in white marble by eminent artists: the remainder of the extent of the building is occupied by the grand staircase and reading rooms. Several rooms parallel with the piazza are occupied by the various apparatus of instruments, for conducting experiments in natural philosophy. These apartments look into the Fellows' garden. The library consists of 40,000 volumes, collected by Archbishop Usher, Dr Gilbert, Dr Palliser, Archbishop of Cashel, and by several persons who gave small parcels, valuable either for the rarity or exactness of the editions; and besides these, the college bought the books of the Bagel library, which was valued at L. 20,000, though they were sold at a rate much less. There are also in the library several hundred rare and valuable manuscripts, relating to the Irish language and history, the Scriptures, arts, and sciences. The college park, to the east of the inner square, contains about eight acres, and is intersected by spacious gravel walks, which have the advantage of sun and shade, from the well-arranged distribution of the plantation. The printing-house, with a stately front of white hewn granite, is on the north end of the great gravel walk, and opposite to it is the anatomy-house. Among many other rarities in this house, is the celebrated wax work of M. de Houe, of Paris, a work of forty years labour, representing the whole progress of the human fetus, in figures as large as life; and the valuable gift of the first Marquis of Lansdown. These figures are in a separate room, in large glass cases, and are in fine preservation. For an account of the Observatory, see OBSERVATORY.

The provost's house is on the south side of the western front of the college, and to the west of the Fellows' garden: it is built on the plan of Burlington-house, noticed in Campbell's Vitruvius Britannicus. The whole site of the college ground occupies twenty-five acres. Its government is in the provost and seven senior fellows, with appeal to the chancellor, vice-chancellor, and visitors. There are besides fifteen junior fellows, who are the teachers; five royal professors, of divinity, common law, civil law, medicine, and Greek; also Archbishop King's lecturers, of divinity and of Greek; two royal professors of modern languages; Erasmus Smith's professors, of mathematics, Oriental languages, oratory, natural philosophy; Andrews' professor of astronomy; Mrs Donnellan's lecturer; the professors of anatomy and surgery, of chemistry and of botany; Sir Patrick Dunn's professors, of the institutes of medicine, of the practice of medicine, and of the materia medica, and pharmacy. The students are ranked in three classes,—fellow-commoners, pensioners, and sizars. The expense of the first class is about L. 100 per annum, and the second about L. 70; the third class, about thirty in number, are chosen after examination as the best answerers, and admitted into the establishment to have commons as a premium.

The revenue of the college arises from the estates in the northern counties: the distribution of it belongs to the board of senior fellows, each of whom has L. 1000 per annum, and the second about L. 70; the third class, about thirty in number, are chosen after examination as the best answerers, and admitted into the establishment to have commons as a premium.

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Dublin. 

The College of Surgeons is a stately building of mountain granite, on the west side of Stephen’s Green, and is provided with all the apartments suited to the profession, with a spacious theatre for anatomy, a burial-ground, a museum, and a library. The secretary is resident, and has apartments with every accommodation.

The Duke of Leinster’s town residence, and that of the Marquis of Waterford, have spacious enclosures, and are built of Portland stone. Those of the Earls of Charlemont, Powerscourt, and Aldborough, are also built in the same manner, but are not enclosed in the front. The Earl of Moira’s house was built in the last century, and though of brick, is very magnificent. The houses of the other noblemen are built of brick, in the modern fashion, and in appearance are not to be distinguished from the other buildings, but by the range.

The public buildings connected with trade, are the Bank, the Custom-house, the Royal Exchange, the Commercial Buildings, Linen-hall, the several halls belonging to the guilds of the trades carried on in the city, and the Post-office.

The Bank is on the north side of that large open space before the west front of the college. It was the Parliament House, and was begun in 1729, during the administration of Lord Carteret, and finished in 1799, at the expense of L.40,000. The lantern and western fronts, with the circular curtains connecting them with the south front, cost nearly as much; and the court of proprietors has added greatly to the internal convenience, in addition to the expense of the building erected for the accommodation of the guard: it is built of Portland stone. The grand portico in College Green extends 147 feet: it is in the Ionic order. The centre vestibule is in recess 40 feet, and the entablature of the advancing vestibules of the portico is ornamented with statues. The cash office is the hall which leads to the rotunda, in which form the House of Commons was built. This room, by the throwing down of the House of Commons, is illuminated from the north side, near the ceiling, which is 50 feet high, and by the reflection of a row of mirror windows on the opposite side. The room is 75 feet long, 53 feet wide, and 50 feet high. The offices are numerous and convenient; and every precaution is taken for the protection of the whole from injury. The late House of Lords remains unaltered; it is for the court of proprietors; it is 75 feet long, and 30 feet broad.

This company was incorporated in 1789. Its capital was then L.400,000 in debentures, and L.200,000 in cash. The capital is now three millions, of which two millions three hundred thousand pounds are in debentures, and L.700,000 in cash. Its profits are the interest of the debentures, traffic in bullion, and discounts, besides the remuneration for managing the fund. The profits are so great, that the bank stock is at L.302 per cent. which is L.10, 2s. per cent. for the original subscription.

The direction is vested in a governor, deputy-governor, and fifteen directors; under the restriction that five new directors at least are to be chosen every year.

The custom-house is on the north side of the river, to the east of Carlisle bridge, and where the course of the river is the wildest, and confined by the straight embankments to the harbour. The building was begun in 1767, and finished in 1791. It is 975 feet in front, and 300 feet in depth, and has four fronts of different designs. It is composed of pavilions at each end, which unite with the centre by arches. The order is Doric, and is finished with a bold, projecting medallion cornice. In the centre, a portico supports a pediment, which is enriched with a group of figures in alto relievo. They are Hibernia and Britannia embracing. They bear the emblems of Peace and Liberty, are seated in a
naval car drawn by sea-horses, are accompanied by Tritons, and followed by merchants' ships, laden with the produce of different nations, and wafted by the winds. Four allegorical statues, Industry, Commerce, Wealth, and Navigation, are placed on the attic over the pediment. A magnificent dome rises 75 feet above the building, and on it is placed a female statue of Commerce. The pavilions at both ends are decorated with the arms of Ireland in an elliptic shield, supported by the lion and unicorn, and decorated with festoons of fruits and flowers.

The entrances are ornamented with allegorical colossal heads. Over the four columns of the north front are four statues, representing the four quarters of the world. The whole south front is of Portland stone, and the others of white mountain stone. The columns, cornices, and architraves, are of Portland stone. The great room for business is 70 feet long, 63 broad, and 30 high. Rows of columns on each side form open recesses for the offices.

Opposite to the east front there is a large wet dock, which contains 40 sail, and contributes much to the dispatch of business. The total expense of this building is reputed to be L.255,000. The authority of the commissioners extends to the whole kingdom.

The Royal Exchange was begun in 1769, by a parliamentary grant of L.13,500, which purchased the site on the activity leading to the castle. It was finished in ten years, and opened in the beginning of 1779. It cost L.60,000, and was raised by lotteries to which the state lottery. The building is nearly square, and crowned in the centre with a fine dome, supported on the inside by 12 composite fluted pillars, which form a circular walk. Above these pillars are 12 circular windows. The centre of the dome has also a large window that illuminates the whole.

A bronze statue of his Majesty George III. in a Roman military habit, executed by Van Nost, at the charge of the late Duke of Northumberland, is placed on an elevated white marble pedestal, on a range with the columns in the rear, and opposite to the great entrance. The geometrical oval staircases at each end of the north entrance lead to the coffee-room and the other apartments, which are all occupied for business relating to merchants. The building on three sides is of Portland stone, in the Corinthian order, with their suited entablatures. The north front has a pediment, with a projection of ten feet; and the west front has only a projection of the entablature supporting a balustrade which surrounds the whole building, excepting the interruption of the pediment of the north front. The straight opening of two streets to the north front, gives a full view of its elevation. At the distance of 120 perches, the acclivity of the ground rendered it necessary to protect the ascent by a balustrade and walk. The balustrade is supported by rustic work. The trustees are the lord mayor, sheriffs, city representatives, treasurer, senior master of the guild of merchants, and twelve merchants. In a niche in the western staircase, there is a beautiful pedestrian statue of Dr. Lucas in white marble, in the attitude of addressing an assembly, and placed on a pedestal. There is in bas relief on the pedestal, a representation of Liberty seated, and ornamented with her rod and cap.

Thirty steps of ascent, by the geometrical staircases to the apartments of the Royal Exchange, were found so inconvenient, that the merchants determined to have on the ground plan a set of offices in a court, where business could be transacted within a minute's walk, which was accomplished by the royal charter Jan. 1, 1798. This company elects 15 members, who conduct the business for one year. Thus in the centre of Dame Street, this commodious building was erected; where a mercantile stranger can have every accommodation he can desire. The debentures of the subscription fund are much above par.

The linen hall is a very commodious building, and was opened in 1728; and from time to time has since yard half received many large additions, which give security and convenience to all the manufacturers and wholesale merchants throughout the year, without expense for the lodging and the showing of their goods. The rooms for this purpose are 400, neatly fitted out. The appointment of trustees by the act of 1709, and the execution of the act by the election of the trustees of the linen and hempen manufactures, raised this branch to the rank it now holds. The exports of linen in 1700, amounted in value only to L.14,112, and the number of yards exported, were:

<table>
<thead>
<tr>
<th>Year</th>
<th>Yards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1713</td>
<td>1,819,516</td>
</tr>
<tr>
<td>1757</td>
<td>30,728,728</td>
</tr>
</tbody>
</table>

The corporation halls are all commodious buildings. The weaving hall is decorated with a pediment, supported by a projection, and a fine pedestrian statue of his Majesty George II. in his robes.

The post-office is opposite to the bank, in a commodious range of brick buildings. Finding that the dispatch of the mails is interrupted by the want of a courtyard, a range of ground in Sackville Street, on the north side of the river, and nearly as convenient in point of distance as the present site, has of late been chosen by the government for this purpose. Each mail coach, with its entire company, is to proceed into the court, to which no stranger on foot is to be admitted; then to receive the mail, and proceed in its course through the gate on the opposite side. All the great roads are in right lines from the place chosen. The present establishment has given great satisfaction, by the expedition and punctuality of the delivery, both in the penny post, and country carriage.

The Grand Canal Company was first formed in 1765, and incorporated in 1772. After various difficulties, the sum of L.100,000 was raised by subscription, the object was to open a communication between the city and the river Shannon. In 1768, it was opened for passage boats, from the west end of the city to Sallins, 13 miles; in 1786, to Monasterereven, 224 miles; in 1806, to Shannon harbour, 63 Irish miles from Dublin. Passage-boats by day and night proceed through the whole course of the direct line to Shannon harbour, and to the off-line of the Barrow navigation. They are all well appointed, and accommodated with every necessary refreshment. It crosses the Liffey on an aqueduct bridge of seven arches, and pierces the hill of Downing several hundred yards; runs through a part of the bog of Allen, and falls into the Barrow at Monasterereven. It is navigated by boats of 30 and 40 tons burthen. The supply of the stream is principally from the Great Morrell, twelve miles from Dublin, at the fifteenth lock. The locks are 26 in number, six double and 20 single; the falls in which vary from 4 feet 3 inches to 19 feet 7 inches. The summit level is 202 feet 4 inches above the city harbour in James's Street, 82 feet 9 inches above the Barrow at Monasterereven, and 260 above high water mark in the Liffey in Dublin. The 39 feet 8 inches full deterred the company from engaging in the
Dublin. 175

Dublin has for nearly a century been the staple of all the imports, and the exports consumed in the twelve counties west of Dublin and Wicklow. The communication by the canals has assisted this commission trade. The exports from Dublin are chiefly corn, live cattle, butter, and linen.

The woollen manufacture flourished in the southwest district of the city, when it was stopped by the law enacting a high duty, and thus prohibiting the exportation, about the year 1698. At present the number employed would not furnish an eighth of the consumption of the kingdom; without capital, without machinery, without fuel in any proportion in these several respects to the manufacturers of the same class in England, an observer is astonished at the artifices practised to avoid the small protecting duty laid on by the act of union, the policy of which was evidently to give an opening to human ingenuity in this branch, without a possible prejudice to the interest of the sister kingdom.

The cotton and silk manufactures have their special excellence alone to recommend them. The protecting duty on the cotton goods will shortly expire.

Among the number of hospitals, there is one for lying-in women, which is principally supported by the profits arising from musical entertainments, balls, and card parties, which are given by subscription at the Rotunda, and great assembly rooms in Cavendish Row adjoining the Rotunda. Dr. Bartholomew Moss, a licentiate of midwifery, in 1745, began this charitable institution in South Great George's Street; and finding it not sufficient for this purpose, took a field in Great Britain Street, then at the extremity of the City Buildings, (and now nearly in the centre of them;) and in 1751 expended not only his entire fortune, about L.2000, but also all the charitable donations he had received, and money borrowed to the amount of L.6000. In 1754, the zeal of the Doctor, unable to fulfil his design by the means which he supposed to be within his power, applied by petition to the House of Commons, and obtained not only the L.6000 borrowed, but also the L.2000 of his own property, and L.6000 in addition, to complete the whole design. Its use may be estimated by the following bare account from the day it was opened. From December 8, 1757, to October 31, 1809, there were 64,010 women delivered of 30,831 boys, and 31,129 girls. The usual admittance every year is 2600. The building is incomparably well fitted for its purposes. It is entirely built of brown stone, and ornamented on the north and south with regular architectural fronts. A beautiful steeple is in the front, and semicircular colonnades form the wings. To the east of the house is the rotunda, 80 feet in diameter, with convenient recesses; it is connected with the apartments in Cavendish Row, the front of which is of white granite, and of the Doric order, in the frieze of which the arms of Ireland, the stars of the order of St. Patrick, and the crest of the Duke of Rutland, are agreeably united. These apartments consist of a ballroom 60 feet by 40; a card-room 60 feet by 35; a tea-room 54 feet by 24; a great supper-room 86 feet by 40; a lesser supper-room 54 feet by 24; four dressing-rooms, each 19 feet by 13; a hall 40 feet by 30; a waiting-room 36 feet by 20; a chairman's hall 40 feet by 20; a vestibule 20 feet by 14; and kitchens with all their offices. The physicians are a master, and two
Dublin.

Squares.

The six squares within the buildings of the city, which are all ornamented with great care, and decked with those shrubs which can endure the situation, are never-failing sources of amusement to the numerous well-dressed and orderly assemblies on these promenades. Stephen's Green, the largest of them, being 400 yards by 300, is now given up by the corporation of the city, to be laid out in such a manner as will correspond to the stately memorial of national respect to the Duke of Wellington. A tribute of this nature was, in the beginning of the last century, erected to William the IIId. In 1765 the pedestal was repaired, and the statue replaced.

The equestrian bronze statues of his Majesty George I. in the garden of the city mansion-house, and that of his Majesty George II. in Stephen's Green, are lasting memorials of the talents of Mr Van Nest.

The citizens of Dublin have shown their respect for the memory of Lord Nelson, and of the brave men who fought under his command, by the erection of a turret, ornamented on the outside as a pillar. It is erected in Sackville street, which is 100 perches long, and six wide, and in that part of it where it is crossed by two streets at right angles meeting each other, and of the same extent, having on the south Carlisle Bridge, and on the north the side termination of the Rotunda Buildings. The base is twenty-five feet high, and the dates and places of the four great victories are carved on the monumental slabs. On the west side is inscribed, “St Vincent, 14th February 1797;” on the north, “The Nile, 1st August 1797;” on the east, “Copenhagen, 2d April 1801;” and on the south, “Trafalgar, 21st October 1805.” The base is enclosed by an oval iron palisade, ornamented with tridents and lamps. The ascent to the summit of the turret is by 166 steps: there is there a gallery with an iron quadrangular balustrade, and in the centre a pedestal twelve feet high. On this the colossal statue of Lord Nelson, also twelve feet high, leaning on the capstan of a vessel, is placed.

This city, according to Ptolemy, in the year of our Lord 140, was called Archalea, and Ebiana Civilia. Alpinus, a poet, in mention of it, in 155, changed it into Athlone, in sorrow for the loss of his daughter, who was drowned in the river. In 181, the Irish called it by its appearance, Drom chail coill, the brow of the hazel wood; also Ath Cleath, the ford of hurdles; also Ballin leath, the town at the harbour of hurdles; and Dub leane, the black harbour, and hence is the contraction of Dublin.

The rising of the tide renders the approach to the river, even at low water, so difficult, by the quantity of mud deposited, that it became necessary to lay hurdles on the strand. In the summer season, at low water, the river has not a foot of water in the centre of the city, so that the building of a bridge was no object to the inhabitants. So late as 1610, there were but 50 perches of embankment on the north side about Dublin Bridge, now called the Old Bridge, and at that time the only bridge connected with the city.

The Danes were in possession of the city in the 9th century, in 851, and built the ancient walls to protect themselves from the surrounding inhabitants. Notwithstanding the victory gained by the Irish over them in 1014, near Clontarf, their chiefs kept possession of it, built churches, and founded abbeys, in and near Dublin, 24 years after this period. They remained in possession for 134 years, until they were expelled by the united forces of Dermot Fitzmaurice, or MacMurrough, chieftain of Leinster, and of the English adventurers under the command of Raymond le Gros. The marriage of Earl Strongbow with the daughter and heiress of the chieftain of Leinster, gave the Earl the right to transfer it to Henry II. He granted to the inhabitants a charter, and also encouraged, by the value of the grant, several Bristol men to bring their families and settle in it.

Four years after, he created his son John, then but twelve years old, Lord of Ireland, a title which the king assumed, in consequence of a treaty with the Irish chieftains, who had been harassed by constant wars, which the limited powers of the first chieftain could not check. Thirty-three years after, in 1210, King John met twenty other chieftains, who bound themselves, by treaty, to adopt the English law and customs. In 1216, Henry III. granted a new charter; and the year following he granted the city in fee-farm, at 200 marks per annum. The tolls were collected; two-pence only was paid for a barrel of wine, which cannot now be brought in for less than L. 10 sterling. In 1298, the magistrature was styled provost, and his immediate assistants bailiffs. In 1409, the title of provost was changed to that of mayor; and, in 1517, the bailiffs became by title sheriffs. In 1560, the mayor was decorated by the gift of a golden collar, and honoured with a company of foot guards. In 1665, the additional titles of right honourable, and lord, were added by the king. In 1672, new rules were instituted for the better government of the city, by Arthur Earl of Essex; and these were improved by the act of 1793, the 33d of his present Majesty.

The lord mayor, and twenty-five aldermen, form a board in a separate chamber; and the sheriffs and sheriffs peers, with 96 freemen, chosen by the 25 corporations in their respective halls, in a separate chamber, are the electors of the city magistrates. Sheriffs peers are those who had served that office, or been elected, were excused, and paid the charitable fine substituted for service. When they exceed 48 in number, the juniors have no privilege. The freemen of the twenty-five corporations can only, in that in which they were first made free; and the elected are those alone who at that time followed the business, or followed it five years, or served an apprenticeship to it; and the corporation of merchants is the only one exempted from these regulations.

The sheriffs, sheriffs peers, and the 96 freemen, name eight persons who are freemen, each worth, in real or personal property, L. 2000, and above all their just debts, two of whom are to be chosen for that office by the lord mayor and aldermen, or the usual quorum of them. In the event of death, or resignation, four freemen are to be named in the same form, for the choice of one to fill the vacancy.

The lord mayor and the aldermen, or the usual quorum of them, send the name of the alderman chosen by them to serve the office for the ensuing year, to the sheriffs' assembly for their approbation, without which no person is capable of serving that office. In the failure of either assembly doing their duty, the other is enabled, by the statute, to make a valid election. All election is by ballot, and no person chosen lord mayor, sheriff, recorder, or town-clerk, is capable of serving that office until he be approved of by the chief governor and the privy council.
The revenue of the city arises from the rents of the landed estate, a great part of which had been let when the acreable value was very low: from tolls received on the commodities that come into the city for sale, or in bulk for private use: from the fishery of the river of Dublin: from fees of admission into the corporation: from the fees for the administration of justice, for ascertaining the weight of commodities, and their quality.

The ground rent of the streets in the city varies from 5s. to 9s. sterling per foot. The usual breadth is from 21 to 25 feet in front, and 125 feet in depth. The building of a good house of five stories, including the cellar, with suitable out-offices, cost L1,500; and of course it is valued at a rent in proportion to the expenditure of L8 per cent.

The taxes of a house now described amount to L4.5 this year (1814). The window tax is doubled; and for 28 windows is L20, 9s. 6d. Irish; besides the heavy taxes that have been charged for the several public buildings lately erected. The city tenures are seldom of a longer duration than the probable existence of the buildings erected in them: this should induce the legislature to empower the commissioners of these improvements to borrow money by debenture, to be replaced by a moderate tax, which would in time repay the principal borrowed, and all its interest. This observation arises from the oppression felt by the operation of the act for making public sewers: the commissioners were empowered to levy the whole sum from the tenant in possession, without any regard to his interest in the premises.

The prisons have all been rebuilt within these thirty years. The great felon's prison cost L16,000. It is quadrangular, and the longest side is 170 feet, and the other 120 feet. It consists of four stories, including the cellarage, where those under sentence of death are lodged. The angles are towers for recesses, which are so badly arranged, that the foul air is forced out on every change of weather, through the wards of the prison. This circumstance, and the conviction that the court-yard should be left open on one side for ventilation, will, it is hoped, influence the government to examine this matter fully. There is an allowance of food and bedding fairly distributed to the prisoners, under the inspection of the chaplains.

The Black Rock on the south side of the Bay, and Clontarf on the north side, are bathing towns well built. They have the accommodation of regular stages; also of a great number of carriages at the stand always ready, and of a twopenny post. See Ireland. (d. f.)

DUBOISIA, a genus of plants of the class Dicydynamia, and order Angiosperma. See Brown's Prodromus Plant. Nov. Holl. 6th. p. 448; and Botany, p. 257.

DUCK. See Ornithology.

DUCTILITY, is the property possessed by metallic bodies, of being drawn out to a fine wire.

The ductility of a metallic wire is therefore the resistance which it opposes to a force acting in the direction of its length, and is measured by the weight which is necessary to break a wire of a given thickness.

The malleability of metallic bodies is the property which they possess of being extended, either by pressure, or by the repeated blows of a hammer, into flat plates or leaves, without having their texture injured. The word tenacity is the general term which includes both the properties of malleability and ductility.

The following Table contains the metals arranged as nearly as can be done in the order of their malleability:

<table>
<thead>
<tr>
<th>Names of metals</th>
<th>Thickness of leaves into which they can be hammered</th>
<th>Ductility, Dull.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>20.10</td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td>187.13</td>
<td></td>
</tr>
<tr>
<td>Platinum</td>
<td>Not determined</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>Do</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>Do</td>
<td></td>
</tr>
<tr>
<td>Tin</td>
<td>Do</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>Do</td>
<td></td>
</tr>
</tbody>
</table>

The following Table, drawn up principally from the experiments of Guyton Morvean, shews the ductility of the different metals, as measured by the weight which a wire of each 0.078 of an inch in diameter are capable of supporting, without being drawn asunder:

<table>
<thead>
<tr>
<th>Metals</th>
<th>Pounds Avoirdupois</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>549.25</td>
</tr>
<tr>
<td>Copper</td>
<td>302.26</td>
</tr>
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Antimony     | 7.00

For further information on this subject, see Glass, Gold, and Wire-drawing. See also Ann. de Chim. vol. lxxx. p. 189. (w)

DUEL, (bellum inter duos,) a single combat, at a time and place appointed, in consequence of a challenge. It must be premeditated, otherwise it is called a rencounter.

The practice of deciding differences by single combat has prevailed from the earliest ages of the world. Single combat prevailed from the earliest times. Of this we have many striking instances, both in sacred and profane history. But these combats were very different from the duel, as it is now practised. In the ancient history of civilized nations, such a species of warfare is not to be found. It is a peculiarity of modern times.

The origin of the duel is to be sought in the superstitions customs of the Scandinavians and other northern nations. Among all such nations, courage seems to have been the ruling principle. This principle, impatient of the forms of law, impelled them to avenge their own wrongs at the point of the sword; and whoever declined to do so, was branded with the appellation of cowardice, and on that account looked upon as infamous. Patricius informs us, that it was the practice of the northern nations, from the earliest ages, to decide their disputes with arms.

This practice was intimately connected with their notions of religion. The belief of a Providence seems to be interwoven with the principles of the human constitution, since it has clearly manifested itself in every age of the world. But till revelation threw light upon this interesting doctrine, it was the general opinion, that adequate rewards and punishments were distributed in the present life. The prosperous were regarded as the objects of the divine favour, while the afflicted were looked upon as suffering the punishment of their crimes. Hence the single combat was viewed as a direct appeal to heaven, and he on whose side victory declared was believed to have the juster cause. It was employed
DUEL.

In several countries, too, to avoid the shedding of blood, the accused were allowed to clear themselves by oath. This oath, in important cases, was made to extend to a number of witnesses, who were all obliged to swear to the innocence of the accused person. In this way, considerable care was taken to arrive at the truth. But as the most turbulent and wicked are always least restrained by the sanctions of religion, the guilty were often led to vindicate themselves by swearing falsely.

Opinion of the German nations,

Tacitus informs us, that when one German nation intended to declare war against another, they endeavoured to take some person prisoner, whom they obliged to fight with one of their people; and by the event of this combat they judged of the success of the war. They considered it, whatever it was, as a decree of heaven, ever attentive to punish the guilty.

This summary mode of obtaining justice accorded with the character of the people among whom it prevailed; and having once gained ground, it was reduced to regular form, and made part of the legal jurisprudence. Magistrates appointed the place where the combatants were to fight, the weapons they were to employ, and all the circumstances connected with it. Both the accuser and accused gave pledges to the judges that they would abide by the issue of the trial. And so far did the custom prevail among the Germans, Danes, and Franks, that none were exempted from it but women, sick people, cripples, and such as were under 21 years of age, or above 60. Even ecclesiastics, priests, and monks, were obliged to find champions to fight in their stead. The punishment of the vanquished was either death, or mutilation of members, according to the circumstances of the case.

This practice, originally adopted for discovering truth, and preventing perjury, gradually degenerated into a species of self-avenging power, not only tacitly permitted, but publicly authorised; and its laws and regulations were accurately defined in most kingdoms of Europe.

Under the feudal system, the duel was warmly patronised. The haughty barons, regardless of the principles of law and justice, considered their sword as the avenger of their wrongs, and disclaimed to submit to any thing but their own strength and prowess for obtaining satisfaction. They were ignorant and untractable. They were fierce, cruel, and oppressive. The administration of public justice was impeded by the force of private animosities, while every domineering chief not only made himself the determiner of his own cause, but claimed the sole power of judgment over his vassals. These he protected and defended in all their depredations on others, but held them himself in the most absolute slavery. A powerful baron seldom appeared abroad in those times, but with the view of plunder or freebooty, or to execute some purpose of revenge or lust. And having accomplished his purpose, he retired within the gloom and entrenchment of his impregnable castle, which was equally fortified against the admission of his rival baron, or his lawful sovereign.

These evils gradually arose to an alarming height. Every kingdom was distracted by the private quarrels and petty wars of a lawless aristocracy. War and the duel were the ruling passions to which all considerations of religion, justice, and humanity, were made to bend. In such a state of society, some possessed of more enlightened views and better principles, endeavoured to direct and control this torrent of unprincipled courage and military violence. With this view, they formed themselves into societies for the relief of injured innocence and distressed virtue, for the redress of oppressions and grievances, for the protection of the weak and defenceless, for the correction of abuses, and the promotion of the public good.

Hence originated chivalry and knight-errantry, which at the same time modified and increased the practice of duelling. Chivalry certainly tended much to soften the manners of the age in which it originated. It not only taught mankind to carry the civilities of peace into the operations of war, and to mingle politeness with the use of the sword,—it roused the soul from its lethargy, invigorated the human character, and produced exploits which have been the admiration of succeeding ages. But while it produced these effects, it gave birth to punctilious refinement, and sowed the first seeds of that fantastic honour, the bitterness of whose fruits are still felt in the modern duel. Every youth of distinction, being trained in this school of honour, was taught to consider military fame and personal valour as almost the only sources of glory.

But to preserve this valour from degenerating into brutal force, a new code of punctilious and refined observations was introduced, on the principles of which the laws of modern honour are founded. The grounds also of the duel or single combat were widely extended. Persons invested with the honours of knighthood did not fight out of malice or revenge, but to signalize their bravery in the protection of the defenceless, and in maintaining the glory of their respective nations. At all banquets of consequence, feats of personal valour were exhibited. Tournaments and tournaments were the common sports and pastimes of the age; and those combats were often countenanced by the presence of the prince and his whole court. When Edward III. and his gallant son invited knights of all nations to be present at these tournaments, when the most distinguished females graced them with their presence, and the champions were eager to lay the trophies of their victory at the feet of those they loved, no wonder that they were urged on to the most remarkable displays of valour.

These tournaments continued long in high estimation. But the death of Henry II. who was killed in one of them, gave a death-blow to their progress; and the renown of chivalry fell with that monarch to rise no more, but in the tales of romance. The duel, however, which had grown up along with it, was not so easily stopped. It had arisen to such a height, as to call loudly for the interference of public authority to check its extravagance. The challenge of Francis I. to his rival, the Emperor Charles V. countenanced this practice. From that time, the single combat on private and personal injuries increased with rapidity. An over-refined sense of honour was ready to construe every thing into an affront. An unguarded word, a haughty look, and a disdainful carriage, were often productive of the most fatal consequences.

From this period we may date the origin of the modern duel. The subjects of Francis, fierce in their courage, lofty in their sentiments, and punctilious in their manners, now indulged their native propensity to the single combat, under the countenance and even injunction of their monarch, who left it to his successors to feel the weight of the growing evil.

As the practice of duelling nowhere rose to a greater height than in France, so in no country were more
Duel.

Duels still permitted in Malta.

Edict of Louis XIV.

Means employed by Henry IV. to prevent it.

First royal prohibition of duels in France.

Duel.

179.

But we Popes, was the council held in 855, Nicholas I. and last of all, the council of Trent in Session xxv. chap. 19. This council terms it a detestable custom, introduced by the devil for the destruction both of body and soul, excommunicating not only all those who fought themselves, but all their associates, and even the spectators of the battle.

Kings and princes also attempted to abolish it in their dominions. Philip the Fair, at the close of the 13th century, wished to suppress it; but the spirit of the times so much opposed his good intentions, that he could effect nothing more than publish an edict, by which nothing was to be brought to that issue, which could be determined otherwise. This edict was but little regarded. Things went on as before till the time of Henry II. when one of his favourites, having fallen in a duel in his own presence, he took an oath never to allow any duel during his reign, and he published an edict to that effect. This seems to have been the first royal prohibition of duels in France. But notions of punctual honour had prevailed so much, that it was doubtful whether this prohibition did not serve to increase the number of private duels. For before this reign, trials of this nature were only permitted on serious occasions, or in instances of great personal offence, and those who dared to fight without obtaining the royal permission were deemed guilty of high treason. But as no such consent was now to be obtained, every man conceived himself a judge of his own case, and, dreading the least imputation of his personal courage, was more ready to stretch the usual points of honour than to curtail them. Honour, too, is of such a delicate and tender nature, as to exert itself most in satisfying those points which are not of strict legal obligation.

The parliament of Paris, June 26, 1599, declares all those who have any way assisted or been present at duels held for such unlawful prosecution of quarrels, rebels to his majesty, transgressors of the law, and disturbers of the public peace. In consequence of which, Henry IV. in his edict at Blois 1602, mentions that the disorders arising from the custom of fighting duels for the reparation of honour, were so great, and so much Christian blood was spilt by them, that he could not judge himself worthy of swaying the sceptre, if he did not put a stop to that abuse. During the first eighteen years of his reign, not fewer than 4000 gentlemen are said to have perished by the duel in France. In June 1609, besides the penalties already imposed, he ordained punishment for all who were any way concerned in duelling, not only the principals, seconds, and carriers of challenges, or offensive and provoking words, but for such as came as spectators, without intention of fighting, and even for those also, who, coming accidentally, did not endeavour to prevent the effusion of blood; and that by death, confiscation of goods, loss or suspension of places, fines, imprisonment, degradation from honour, and infamy, according to the share they had in the murder.

In the beginning of the reign of Louis XIII. to elude the force of former edicts, it was attempted to class duels under the head of accidental encounters, upon the pretext that no challenge was previously given. This induced that prince to extend the former edicts respecting duels to encounters also. The practice, however, went on, in spite of every attempt to put a stop to it. Edicts were passed, every one severer than another, but the evil continued to gain ground. There is scarce any Frenchman, says Lord Herbert, deemed worth looking on, who has not slain his man in a duel.

Louis XIV. set himself to oppose this bloody practice, and issued many edicts to that purpose. In particular, he published a famous one in 1679, which did more to restrain duelling than all the attempts of his predecessors put together. A solemn agreement entered into by many of the principal nobility and gentry of the kingdom, contributed greatly to this effect; and also his own firmness in refusing all solicitations in behalf of offenders. To check this alarming evil seems to have been one of the chief wishes of his heart, since in his last will he particularly recommends to his successor the care of his edict against duels. From that time they have been much less frequent than before.

In 1712, Augustus, King of Poland, published a severe edict against duelling, consisting of no less than 62 articles. And now, perhaps Malta is the only country in the world where the duel is permitted by law. In Bydalone's Tour, we have the following account of it.

"As their whole establishment is originally founded on wild and romantic principles of chivalry, they have ever found it too inconsistent with these principles to abolish duelling; but they have laid it under such restrictions as greatly to lessen its danger. These are curious enough. The duellists are obliged to decide their quarrel in one particular street of the city, and if they presume to fight any where else, they are liable to the rigour of the law. But what is not less singular, and much more in their favour, they are obliged, under the most severe penalties, to put up their swords when ordered to do so by a woman, a priest, or a knight. Under these limitations, in the midst of a great city, one would imagine it almost impossible that a duel could ever end in blood. However, this is not the case. A cross is always painted on the wall opposite to the spot where a knight has been killed, in commemoration of his fall. We counted about twenty of these crosses."

Though duelling was never carried to such an extent in this island as in France, in both kingdoms it originated from the same source, and owed its progress to the same causes. The judicial combat prevailed much in England, especially about the time of Edward III., and made a part of the law of the land. So late as the year 1571, in the reign of Elizabeth, a demand was made for a decision by judicial combat, concerning the right of some manorial lands in the small isle of Hartie, near the isle of Speey, Kent. A proceeding was instituted in the Court of Common Pleas against the holder of the lands. The defendant demanded leave to maintain his possession by the duel; the petitioners accepted the challenge, and the whole bench of lawyers was put into confusion how to act upon this appeal. This proves that the judicial combat was still held to be a legal mode of proceeding when both parties were agreed, though it had fallen much into disuse. The law courts do not seem to have had a power of refusal. Accordingly, champions were immediately chosen by each party to decide the combat, and all the requisite forms were adjusted; but the queen, anxious to avoid bloodshed, procured a composition between the parties; at the same time, that the formalities of the law might be gone through, she permitted the duel to proceed. According to the day set, the Justices of the Common Pleas, the counsellors and lawyers, went down to Tothil Fields to be umpires of the contest; and the customary formalities were carefully attended to; but, as it had been previously agreed, the parties did not appear to acknowledge their respec-
DUEL

Duel.

The private duel gains ground.

Attempts made to suppress it.

Law in England respecting it.

In Scotland, duelling had not only been permitted, but also in civil causes. Accordingly duelling is mentioned as one of the general forms and manners of probation used in courts. But the Scottish legislature began to recede from this savage jurisprudence, so early as the reign of Alexander II. when it was ordained that, "in time coming, no judgment or sentence shall be given by water, or in air, as has been used in all times." Single combat maintained its ground somewhat longer; and, in the reign of Robert III. four things were necessary to render duelling legal, 1st, That the crime should be capital. 2d, That it should be certain the crime was committed. 3d, That the accused should be rendered infamous by it. 4th, It must not be capable of proof by witnesses. Judicial combat at length fell into total disuse, with the progressive dawning of a more enlightened jurisprudence; and, for ages, duelling has been no otherwise recognised than as a heinous offence against morality and religion, which it has been thought proper to restrain by the severest sanctions.

If the parties actually fight, and one of them be killed, whatever may have been the provocation, or however fairly the parties may have conducted themselves, this is murder, both by the law of Scotland and England; for the circumstances of sudden provocation, which lower the offence to the denomination of manslaughter, are not understood, by the law of either country, to apply to those who meet avowedly with an intent to murder.

Farther, the mere act of engaging in a duel, whether the parties receive any wound or not, is made capital by the statute 1600, chap. xii. and the provoker is to be punished by a more ignominious death than the other, at the pleasure of the sovereign. This statute makes no mention of seconds; but the subsequent one of King William enactis, that whosoever, principal or second, or other interposed person, gives a challenge to fight a duel or single combat, or whosoever accepts the same; or whosoever, either principal or second, on either side, engages therein, albeit no fighting ensued, shall be punished by the pain of banishment, and the exchequer of moveables, without prejudice to the act already made against the fighting of duels. Both these statutes have lately been declared, by the Court of Justice, to be still in force. There have not, however, been many prosecutions on this statute, which must be considered to be a rigorous law. And Mr Hume observes, he could not find in the records more than two instances of a conviction upon it.

This statute applies only to a serious proposal and settlement of a combat. Ambiguous hints, or innuendos, on the one hand, or on the other, mere verba jactantia; passionate words of defiance, uttered face to face, and only tending to a challenge, are punished arbitrarily at common law, but not by the statutory pains. For example, in the course of a scuffle, one of the persons engaged in it, besides other abuse, calling to another of them to get a sword, and give him satisfaction, was not found a relevant charge under this statute.

Such is the history of duelling, and such the law respecting it. Duelling is founded upon the principles of honour. These principles, when properly directed, exalt and adorn the character, and animate us in the pursuit of what is noble and excellent. But, like all the other principles of our nature, when not properly directed, they are productive of the worst consequences. The object which the duellist proposes is altogether of a personal nature, being either to gratify some passion, which every good man ought to avoid, or to avoid the imputation of cowardice, of which, perhaps, he was never suspected. His object therefore is selfish; and the means by which he attains this object are contrary to law, reason, and religion. He takes the law, indeed, in his own hand, and acts as judge in his own cause. On account of some unguarded word, or some trifling offence, he wantonly risks his own life, and involves, perhaps in wretchedness, a wife and family who depend upon him for subsistence. Religion enjoins forgiveness of injuries,—the duellist thinks only of revenge. Religion recommends patience and forbearance,—the duellist declares, that he who does not resent his own wrongs, is not fit to live in society. Humility is a fundamental principle of the Christian religion,—duelling is supported and nourished by pride: for honour, in the fashionable sense of the word, is nothing else than pride: modified by certain rules.

Hence this practice has ever been reproved by all Sully's wise and good men. The Duc de Sully, one of the first generals of his own or any other age, has transmitted to posterity his testimony against it, in the following pointed language, "That," said he, "which arms us against our friends or countrymen, in contempl..."
of all laws as well divine as human, is but a brutal fierceness, madness, and real pusillanimity." Upon this subject Paley has some excellent observations. "The law of honour is a system of rules constructed by people of fashion, and calculated to facilitate their intercourse with one another, and for no other purpose. It prescribes and regulates the duties between, omitting such as relate to the supreme Being, as well as those which we owe to our inferiors. For which reason, profaneness, neglect of public worship, or private devotion, cruelty to servants, rigorous treatment of tenants, or other dependents, want of charity to the poor, injury done to tradesmen by insolencies, or delay of payment, with numberless examples of the same kind, are accounted no breaches of honour, because that man is not in less agreeable companion for these vices, nor the worse to deal with in those concerns, which are usually transacted between one gentleman and another. Again, the law of honour being constituted by men occupied in the pursuit of pleasure, and for the mutual convenience of such men, will be found, as might be expected from the character and design of the law-makers, to be, in most instances, favourable to the licentious indulgence of the natural passions. Thus it allows of fornication, adultery, drunkenness, prodigality, duelling, and revenge in the extreme, and lays no stress upon the virtues opposite to these."

In the late case of Lieutenant Blundell, who fell in a duel, in the Isle of Wight, not only his antagonist, and his second, but also two others who were deemed accessories, were all four convicted of murder at the Hampshire assizes, and sentenced to die. The royal pardon, however, was obtained for them; but being officers in the army, they were soon afterwards dismissed the service. And the commander in chief, in his general orders, concluded by hoping, "that it will give an useful and impressive lesson to the young officers of the army, and a warning to them of the fatal consequences of allowing themselves to be misled by erroneous notions and false principles of honour, which, when rightly understood, and leading to its legitimate object, is the brightest gem in the character of a soldier."

Dueling has no doubt contributed to soften the rude manners of former times, and to promote that respectful and delicate attention to one another, which distinguishes the inhabitants of modern Europe from the most civilized nations of antiquity. But in checking ferocity, it gave birth to punctilious refinement, and solved the first seeds of that fantastic honour, the bitter fruits of which have been so extensively felt. Chivalry also had a very considerable influence in polishing the manners of a less refined age. In the progress of society, however, it passed away, and gave place to a more sober mode of thinking and of acting; but duelling still prevails to testify, how weak are the restraints of religion and of law, when opposed to the domineering influence of fashion.

This custom originating in a period of ignorance and superstition, has maintained its ground amidst all the improvements of society, and has come down to our times with unabated force. This circumstance is very much owing to the laws which have been passed against it not being carried into effect. When Louis XIV. alarmed at the extent of this growing evil, set himself strenuously to oppose it, it is wonderful with how much success his exertions were attended. And were the governments of Europe now equally strict in enforcing the laws against it, there is every reason to think that the practice might soon be abolished. But when laws are passed and not executed, instead of deterring, they serve rather to encourage offenders. The trifling damages too that are frequently recovered in prosecutions for this offence, serve only to make the sufferers ridiculous.

The most effectual plan for putting a stop to this evil, would certainly be to enforce the laws that are now in existence against it. But, perhaps, something more than this might be done. A court of honour might be established, especially for the army, where the point of honour is cultivated with exquisite attention and refinement, with a power of adjudging those submissions and acknowledgments, which it generally the object of a challenge to obtain. Similar institutions might be formed for other professions, which might go to eradicate this invidious disorder of modern times.

There is some probability, however, that the evil may correct itself. If it descend from the higher to the lower orders, and become common among all classes of the community, the great may be led to renounce a practice which can no longer be regarded as honourable. And if it lose its sanction and authority, there is every reason to think that it will gradually be abolished. See Moore on Duelling. Cockburn's History of Duelling. An account of the Abolishing of Duels in France. Montesquieu's Spirit of Laws, vol. ii. (n)

DVINA, a river of Russia, and one of the largest in Europe. It is navigable, and a great trade is carried on by it and its tributary streams with Archangel. It falls into the White Sea by five different channels, only two of which are navigable. The following rivers fall into the Dvina:

The Pinaq, down which a great quantity of timber is floated.

The Vitzegda, which receives the northern Keltma, a river which the Russian government proposed to unite with a southern river of the same name that joins the Kama. A canal was actually begun, but it was discontinued upon the breaking out of the war.

The Uga, and the Lower Souchona, are two of the principal branches of the Dvina. Great quantities of grain, and other merchandise, are conveyed down the Lower Souchona, from Vologda and its neighbourhood to Archangel. It rises in the lake Koubenska, by means of which it is proposed to open a communication between the Souchona and the river Seleksa.

The Russian government has proposed to unite the Dvina with the Niemen, by means of the rivers Nevesha and Lavenna; and a plan and estimate have been given in by General de Witt. This plan would be of the greatest advantage to all the adjacent country, but particularly to Livonia, Lithuania, Courland, and the country beyond the Oginsky canal. The productions of these fertile regions, instead of being carried into the Prussian ports of Königsberg, Memel, Pillau, &c. would be conveyed to Riga, Kofina, &c. and the native merchant would thus derive all the advantage which accrues from the sale of his goods in his own country. See the Report of the Board of Russian Engineers on the state of the internal Navigation of Russia, in Clarke's Travels, vol. i. Appendix, No. viii. (s)

DULCIANA, stop, in music, is one of the ranges of metal pipes in a organ, long and slender, of a peculiar sweetness of tone, which Mr Stetszler introduced into the choir organ as a sole reed stop. It is tuned in unison with the diapasons, but has less compass than them, descending only to G-gomut. It is a stop that usually stands well in tune. (t)
DUMB AND DEAF.

There is nothing which relates to the intellectual acquirements of early life more certain, than that the noblest of them all, the acquisition of Vocal Speech, depends entirely on the sense of Hearing. The same early lesson of experience which teaches the child, that, by a certain voluntary effort, he can extend his arm, informs him also, that, by a similar exertion of his will, he can produce certain vocal sounds. He endeavours to imitate the words that are spoken by those around him. His first attempts are unsuccessful, because his memory is yet feeble; and because his voluntary actions, in this instance, just as in his first amusing struggles to gain that erect position by which man is distinguished, are irregular and unsure. But repetition brings continual improvement; age develops the other faculties of the mind; and without the least regard to those vibrations in his throat, or those motions of his tongue and lips, by which his purpose is accomplished, he goes on, from indistinct prattling, to the acquisition of clear and perfect Speech, regulated solely by the Ear.

To those, however, who have been born Deaf, or who have been affected with incurable Deafness before articulation had been attained, or sufficiently impressed on the memory, it is obvious, that this natural guide to the acquisition of Speech is utterly denied; and so obscure or unattainable does the only other path to the possession of this important faculty seem to such persons, that, when left to themselves, no attempt is ever made by them to gain it. The records of physiology do not present us with a single instance of an individual born Deaf, or deprived of hearing in infancy or childhood, who did not remain Dumb for life; unless cherished and instructed by the philanthropy and ingenuity of some fellow-creature, more happily gifted than himself.

It is to persons in this condition,—to those who are Dumb merely because they are Deaf,—whose organs of Speech are perfect,—whose intellect is good,—and who differ from other individuals only in being incapable of sensations of sound,—that the term Deaf and Dumb or Deaf-mute is applied.

The task of education is never, perhaps, more truly delightful, than when this unfortunate though interesting class of persons are the subjects of it. They unite, in general, to singular steadiness of application, the greatest gentleness and docility; and expressions of counterance, as cheering as they are unequivocal, continually declare the emotions of gratitude with which they receive instruction. It is pleasant to become their pupils in our turn, and to learn of them that natural pantomime by which all their wants are expressed. Copious, however, and significant as that language is, it is necessarily intelligible but to a few; and it is indeed an exciting satisfaction which they seem to feel, when they are taught to exchange it for the more powerful medium of words; and are thus, as it were, enabled, to command the thoughts of all mankind. We see their happiness increasing with their knowledge; and when the sublimity of nature is first unfolded to their opening minds, and we mark the tear starting into their eyes, we cannot but participate in their noble pleasure, and rejoice that such emotions can be theirs.

In the present article, we propose to state the general principles according to which the Education of the Deaf and Dumb ought to be conducted; avoiding all those minute details which could be of no interest to the general reader; and which even to those who mean to occupy themselves practically with this species of instruction, could be of little advantage; since they are of a nature to suggest themselves to any intelligent teacher, almost as soon as they could be taught.

We suppose the education of the Deaf and Dumb pupil to commence at the age of eight years. By this period, children who enjoy the sense of hearing, have always acquired the full command of their organs of Speech; they have learnt the meaning and application of several hundreds of words; and to the stock of knowledge, which youthful curiosity has stimulated them to obtain, by their own personal observation, within their own limited sphere, they have been enabled to make a most important addition, from the verbal information of others. The business, therefore, of their early education, consists, merely, in making them acquainted with the written and printed characters of those words, whose pronunciation is already familiar to them; and by an analysis of these, pointing out to them all the visible signs of those simple articulate sounds, out of which the whole of Speech is constructed. After this, reading presents them with abundance of new words; and should any of these not be susceptible of explanation by terms already known, they are gradually enabled to collect their meaning, by frequent and attentive observation of the manner in which they are used, in conversation, by others. Nor are their lessons in language confined to the tasks of the school; at meals, at play, abroad, at home, everywhere, they are continually acquiring from the speech of their seniors, either new terms, or new or more correct methods of employing the vocabulary which they already possess.

But the task which the Deaf and Dumb have to enter upon, is much more complicated and difficult. Ignorant of every part of that system of signs, which mankind have invented for the communication of thought, they have to be instructed, not merely in those written characters which are the representatives of words; but in the method of articulating the words themselves, and of distinguishing them when articulated by others; and in the precise meaning which each of them is intended to convey. Many circumstances, too, combine, to render this process tedious. We cannot, in their case, it is obvious, define one word by another; but the signification of each must be taught, either by a direct appeal to things themselves, or the pictures of things; or by the language of gesticulation and natural signs. The narrow stock of knowledge which they bring with them, when compared with those who enjoy the sense of hearing, circumscribes greatly that field of illustration, which is required in the early stages of instruction. And what is a less material disadvantage, they are entirely cut off from that constant source of new ideas, as well as new words, which other children enjoy in their intercourse with society.

Experience, however, has shewn, that all these difficulties may be overcome by perseverance; and in pointing out what appear to us to be the best means of attaining this important object, we shall refer our observations to...
the four following heads, viz. Writing, Manual Speech or Daetaylogy, Vocal Speech, and the Explanation of the Meaning of Words.

The very first step in the education of the Deaf-mute, is, to teach him to write. Writing is a medium of instruction so necessary, in his situation, that it cannot be too early acquired. No particular directions are requisite for this purpose. It may be taught first on sand with the finger, or on a slate with the pencil, in the usual way, and afterwards on paper with pen and ink. Comparatively little attention, however, need be paid at the commencement to the nicety with which the letters are traced. The chief object is to enable the pupil to connect letters together with legible distinctness, as speedily as possible; and, this done, practice will gradually give the manipulation its necessary accuracy and precision.

Along with Writing, the pupil is to be taught the method of representing letters and words by the fingers, or what has been called Daetaylogy. This is an easy task. The Manual Alphabet, which is represented in Plate CCXLI. seems to us very well adapted for the purpose. It is that which is taught by Dr Watson, (Instruction of the Deaf and Dumb, &c. 8vo. Lond. 1809); and which, we should conceive, is both more easily practised, and less liable to confusion, than the one employed by Sabelcard, in which only one hand is employed. (Cours d'Instruction d'un Sourd-Muet de Naissance, &c. 8vo. Paris, 2d edit. 1803.)

The uses of this Manual Speech are obvious. It is much more expeditious than writing; it can be practised in any situation, and without any such implements as slate, or pencil or paper; it admits of being addressed to several at a time; and, what is a most important advantage, it affords a medium of communication between persons who are placed at a considerable distance from each other. Dr Watson, too, assures us, that it is intelligible to the touch, as well as to the sight, and consequently may be used in the dark (Work quoted above, p. 121.) It is remarkable, that even those deaf and dumb pupils who have been taught to speak vocally, always employ this Manual language alone, in addressing each other. Nor is it to be regarded merely as an instrument of education. The Deaf and Dumb, in their after intercourse with the world, will meet with many persons who have taught themselves to speak on the fingers, merely as an amusement, and not from any defect in their organs of hearing or articulation. With such persons, therefore, they may often enjoy the pleasure of conversation in circumstances calculated to render Vocal Speech both difficult and embarrassing.

After the pupil has made a little progress in Writing and Daetaylogy, the more laborious task may be entered upon, of teaching him Vocal Speech.

This, unquestionably, is the most extraordinary accomplishment which it is possible for a Deaf and Dumb person to acquire. That it should be possible to instruct such a person, through the medium of writing, as fully, in every department of human knowledge, as those who enjoy the sense of hearing, does not appear in the slightest degree remarkable; for it is not more difficult to associate our ideas with a system of visible than of audible signs. But that he should be capable of learning both to emit sounds and to articulate them, merely by observing with his organs of touch and sight, those minute vibrations of the throat, and those rapid and delicate motions of the parts belonging to the mouth, which accompany the speech of others, is a thing so singular, that, previously to experiment, we should suppose it almost impossible. Yet it is curious to remark, that this seems to have been a chief object even with those to whom the idea of instructing the Deaf and Dumb first occurred; and that the earliest attempts which are recorded to have been made to teach Deaf-mutes to speak, appear to have been attended with complete success. In truth, all those who have enjoyed much experience in the education of the Deaf and Dumb, agree in declaring, that this is a department of it, in which any one cannot fail to succeed, who resolves to bestow sufficient time and patience on the task; and who has good sense and good nature enough to encourage, by kind arts, the perseverance of his pupil.

In attending particularly to the phenomena of Speech, two things present themselves for consideration: in the first place, the various Sounds which compose it; and secondly, different Modes in which these Sounds are begun or ended.

The Sounds which enter into the composition of Speech may be arranged into two classes; and these shall distinguish by the terms Laryngeal and Oral.

Laryngeal sounds are those which are produced entirely by the larynx. Such, for example, are the sounds of the letters a, o, l, n. A distinction exists among these, which, of course, is familiar to every one; namely, some of them are Vocal sounds, or constitute what is called voice; others are Whispering sounds, and occur only in the whisper.

Both these kinds of sounds, without doubt, depend on vibrations produced in the expired air during its passage through the larynx; though it is not easy to ascertain the causes of the difference betwixt them. We may remark, however, that Vocal sounds are susceptible, not only of various degrees of strength or loudness, according to the different degrees of force with which the air is expelled from the lungs; but also of the greatest variations in tone, from changes in the dimensions of the windpipe, or varieties in the shape or size of the rima of the glottis. Whispering sounds, on the other hand, are susceptible of changes in point of loudness alone, without the slightest perceptible variety in the quality of tone; and we are rather inclined to think, that the vibrations on which they depend, are produced, not more by the aperture between the vocal chords, than by the other parts of the larynx. What is of more importance, however, to our present purpose to be known, is, that during the production of every Vocal sound, a distinct vibration may be felt externally, by applying the fingers to that prominence on the fore and upper part of the neck which corresponds to the larynx, and which is often denominated the pomum adami. But in the production of a Whispering sound, no such vibration can be perceived.

It is not, however, by any changes of loudness or How diverse tone taking place in the larynx, that the Laryngeal sounds employed in Speech are so much diversified; but by differences in what we call, physiologically, their expression, and which depend on certain configurations voluntarily given to the parts of the face and mouth, while the sounds are emitting from the larynx. We are accustomed, in fact, to observe a very great uniformity in the tones and intensity of the sounds we employ in Speech; but were we even disposed to introduce more variety in these qualities, still the Sounds would not undergo any altera-
Dumb and Deaf.

Dumb and Deaf.

The expression of this sound depends on the same parts as the former; only, the surface of the tongue is brought a little nearer to the roof of the mouth, so that the channel through which the air passes is smaller.

6. The sound expressed by the letters $t$ in $t$ all, by $L$.

There are twenty-one Laryngeal sounds, all differing in expression from each other, employed in the English language. We shall consider each of these separately.

1. The sound expressed by the letter $a$ in the words art and at.

In the former of these words, the sound is expressed much more slowly than in the latter; in the one, therefore, it is said to be long, and in the other short. A long sound is usually pointed out by a straight line drawn above the letters representing it, thus, $\text{art}$; and a short one, by a curved line, thus, $\text{at}$. We shall employ these marks for the sake of brevity, in our future illustrations.

In this sound the breath escapes entirely by the mouth, so that it cannot be pronounced when the lips are shut. Its expression depends on a particular position of the back part of the tongue and the velum of the palate.

We will not attempt to describe this; but any one may observe it in himself by means of a mirror. The expression suffers no change, either by varying the position of the lips, or the tongue, or by shutting the nostrils.

2. The sound which is expressed by the letter $a$ in the word hall, by au in taught, by o in hot, and by ou in sought.

The expression of this sound depends on the same parts of the tongue and jaws as the former; only the root of the tongue is a little more arched upwards.

3. The sound expressed by $o$ in note, and by $oo$ in boot.

To give this sound its expression, the back part of the tongue is still a little more arched upwards than in the former.

The expression is a good deal modified by varying the size of the orifice of the lips. In common conversation, it is always pronounced with a small opening of the lips, which gives it a much more hollow expression, than when the mouth is open, as during laughing; and we may observe, that the orifice is always less than during the utterance of either of the two preceding sounds.

4. The sound expressed by $a$ in rare, by $ai$ in wait, by $ay$ in day, by $e$ in shell, by $ea$ in pier, and by $ei$ in feign.

In this sound, as well as in the three preceding, the breath escapes entirely by the mouth. The edge of the tongue on each side is brought into contact with the teeth of the upper jaw, as far forwards as the small grinders; its upper surface is formed into an arch, corresponding to the roof of the mouth, but separated to a certain distance from it; and in the channel thus formed, the air passes forwards, and escapes between the tip of the tongue and the fore-teeth of the upper jaw.

The expression is not altered by shutting the nostrils, nor by varying the relative position of the jaws, nor by changing the dimensions of the orifice of the lips, provided they be not entirely shut.

5. The sound expressed by the letter $a$ in pole, by $ai$ in fail, and by $e$ in their or there.

In this sound, the velum of the palate is so raised as to shut up completely the orifices leading from the throat to the nose; the breath, therefore, passes wholly into the mouth. But the expression of the sound depends entirely on the lips being shut; it cannot be pronounced at all with the lips open. Now, as the air which has been excited into vibrations in its passage through the larynx, is afterwards, in this case, urged by the muscles of expiration, entirely into the mouth, none escaping by the nose; and, as its escape from the mouth is also prevented by the lips being shut, the mouth must very soon be filled with it, and then, of course, the sound will cease, expiration being no longer possible. Accordingly, we observe, that the sound of $b$ is one, upon which we can hardly dwell beyond two seconds.

The situation of the tongue does not much affect the
expression of this sound, otherwise than in increasing its duration and its hollowness, when placed so as to enlarge the cavity of the mouth, and in producing the reverse effect, when in an opposite position. The sound is also prolonged, and rendered more hollow, when we permit the inflation of the cheeks, for an obvious reason; but, in general, this inflation is prevented by muscular actions, simultaneous with those which shut the lips. The position of the jaws does not modify the expression.

11. The sound expressed by the letter d, in day, sad, above.

In this sound, as in the former, the pharyngeal orifices of the nose are shut up by the velum of the palate; and the breath passes all into the mouth. Its expression depends, however, on a very different situation of parts. The edge of the tongue on each side is applied close to the under surface of the five grinding teeth, and to the inside of the eye-teeth, and then the tip is pressed firmly against the roof of the mouth, immediately above the insertion of the incisors. In this way, a completely close cavity is formed between the upper surface of the tongue and the palate, which receives the air from the larynx, and gives it this peculiar expression called d. When the cavity is filled, the sound, of course, ceases, as in the case of b.

It is easy to see that this expression cannot be affected by shutting the nostrils, or the lips, nor by varying the position of the lower jaw. When the tip of the tongue, however, instead of being applied to the roof of the mouth, is placed under the edges of the front teeth, a peculiar modification of the expression is produced, which is extremely common in the dialects of some parts of Scotland, particularly in that of Aberdeenshire.

12. The sound expressed by the letter g in good, dog, begone.

In this sound, too, the passage from the throat to the nose is stopped. The back part of the tongue is raised up towards the upper part of the velum of the palate, and is then applied to it so closely as to form a small cavity with it, opening downwards towards the larynx. The air passing into this, receives its expression; but as the cavity is small, and consequently soon filled, the sound is one of very short duration; considerably shorter than either d or b.

13. The sound expressed by the letter l in lay, fail, alone.

Here, also, the breath passes out entirely by the mouth. The tip of the tongue is pressed against the roof of the mouth immediately above the insertion of the incisor teeth; and the edge of this organ on each side, is applied only loosely to the inner surface of the remaining teeth of the upper jaw; so that the air escaping between these teeth and the edges of the tongue, receives the expression of l. The sound cannot be pronounced unless the lips are open.

14. The sound expressed by the letter m in man, him, amend.

In this sound, the breath is urged alike towards the mouth and the nose; but it is on that portion of it alone, which is directed towards the mouth, that the expression depends. The tongue lies low, so as to allow a large space for air, between its upper surface, and the roof of the mouth; the jaws are slightly asunder; the lips are shut; and it is the breath pressing against the lips which causes the expression of m.

Although it is necessary for this sound that the lips should be closed, and although the air is thus prevented from escaping by the mouth, yet the free passage for the breath by the nose, enables expiration to go on; and if the nostrils be not stopped, the sound may be continued until the lungs are emptied.

When the nostrils, however, are held fast, no more air can be forced from the chest than is sufficient to fill the mouth and face, and consequently the sound cannot be prolonged beyond a second or two.

15. The sound expressed by the letter n in the words.

Here the expression depends on the cavity of the mouth's being shut, not by the lips, as in the former sound, but by the tongue, which is placed exactly in the same situation as in the pronunciation of the 11th sound. With this difference, all the remarks that have just been made with respect to m, apply equally to n.

16. The sound expressed by the letter r in ran, far, around.

In this sound the breath escapes entirely by the mouth. The edge of the tongue on each side is applied to the under surface of the upper grinders and eye-teeth, as in pronouncing d; but the tip, although rendered pretty firm by muscular contraction, instead of being pressed strongly against the roof the mouth, is merely raised so as to touch gently the part immediately above the insertion of the incisors. The air is then urged towards this point, sets the tip of the tongue into vibration, and escapes around its edge. On this the expression of r depends.

17. The sound expressed by the letter v in vow, have, Laryngeal sound.

The expression of this sound depends on the under lip being brought slightly over the edges of the upper incisor and eye-teeth, but pressing only on the two middle incisors with such force as to prevent the escape of air. The breath, then, urged forward from the throat entirely into the mouth, escapes between the under lip and the edges of the lateral incisors and of the eye-teeth.

18. The sound expressed by the letter s in reason and Laryngeal sound.

In this sound the tongue is placed nearly as in the utterance of the 11th, and the breath escapes entirely between its tip and the roof of the mouth immediately above the incisor teeth. The tip of the tongue, however, is not set into vibration as in that sound, but remains steadily in one situation, and the air in its passage receives merely a sort of hissing expression.

19. The sound expressed by s in pleasure, and by z in azure.

Here the edge of the tongue, on each side, is placed under the inferior surface of the upper grinders; and its anterior part is so applied to the roof of the mouth, as to leave only a small funnel in the middle, which terminates behind the incisor teeth in a slight convexity, caused by the tip of the tongue. All the breath escapes through this passage.

20. The sound expressed by the letters th in thus, Laryngeal sound.

In this sound the margin of the tongue, all round, is placed under the whole of the upper teeth; but it is held but loosely applied to the edges of the incisors, so that the air, urged forward from the throat, escapes between it and these teeth.

21. The sound expressed by the letters ng in long, Laryngeal sound.


This is the only Laryngeal sound in our language, in which the breath escapes entirely by the nose. The instant the nostrils are stopped, the sound ceases. The cause of the expression is easily seen. The velum of the palate is brought a little downwards and forwards, and the posterior part of the tongue a little upwards and backwards; they meet together, and shut up entirely the passage to the mouth.

Oral sounds are such as are not produced in the Larynx, but by some of the parts belonging to the mouth. Like the Laryngeal sounds, they are distinguished from each other by their expression; but they differ from these, on the other hand, in not being susceptible of the slightest variety of tone. They are only five in number.

1. Oral Sound.
   1. The sound expressed by the letter c, in the words cider, nicer; by s in sad, asleep, oats; by sc in scene; and by sch in schism and schedule.
   This sound depends on the breath being made to pass through the mouth, without having undergone any previous vibration in the larynx, while the tongue is placed precisely as in the pronunciation of the 18th laryngeal sound.

2. Oral Sound.
   2. The sound expressed by the letter f, in far, soft, afraid; and by ph, in physic, pneumocon, aphorism.
   This sound is caused by the breath being made to pass out by the mouth, without any previous vibration, while the under lip and upper teeth are exactly in the position necessary for the utterance of the 17th laryngeal sound.

   3. The sound expressed by the letter t in nation; by ch in champaign; by sh in show, ashamed, push.
   This sound depends on the same expression of parts within the mouth as the 19th laryngeal sound, the breath passing through without any previous vibration in the larynx.

   4. The sound expressed by the letters th, in the words thick, athwart, path.
   This sound is caused by the breath passing out between the tongue and upper teeth, placed exactly as in the 20th laryngeal sound, but without any previous vibration in the larynx.

5. Oral Sound.
   5. That-soft but distinct sound accompanying the emission of the breath, which we perceive at the end of the words at, sleep, rock, and which occurs between the two sounds expressed by the letters k and n in the word acknowledge.

Thus we find, that there are 26 distinct sounds, Laryngeal and Oral, employed in the English language.

But it is to be remarked in the next place, that there are certain modes, according to which, if these sounds be either begun or ended, a material alteration will often be produced in their meaning.

These Modes are five in number.

1. Mode.
   The 1st Mode is expressed by the letter c, in coal, acme, siro; and by k in karan, wake, lark.
   This Mode consists in placing the tongue precisely in the same situation as in the pronunciation of the 12th Laryngeal sound, keeping it firmly there, and at the same time urging the breath against it, without any vibration in the larynx.

2. Mode.
   The 2d Mode is marked by the letter b, in hold, unhappy.
   This depends on a short and quick action of the muscles of expiration, by which the breath is urged forward with greater velocity than ordinary, and the sound, at its commencement, receives a sudden sort of impulsion.
   This Mode is never employed to terminate sounds, but only to begin them.

The 3d Mode is marked by the letter p, in pay, uphold, stop.
This Mode is caused by the velum of the palate and the lips being brought into the same situation as in uttering the 10th laryngeal sound, and kept steadily there, and then by the breath's being urged forward against the lips, without suffering any vibration in the larynx.

The 4th Mode is marked by the letter t, in table, tone.

This Mode depends on the breath's being urged forward, without any vibration, into the mouth, the tongue being placed exactly in the same situation as in pronouncing the 11th laryngeal sound.

The 5th Mode is marked by the letter n, in ward, wound.

This Mode consists in urging the lips a little forward, bringing them into contact, so as to leave only a small hole in the middle, and then smartly enlarging that orifice the instant the sound begins. The extent to which the orifice is enlarged, depends on the nature of the sound which is to follow.

These few remarks on the elementary Sounds of our language, are intended chiefly for the instructor of the Deaf and Dumb, not for the pupil himself. We have thought it proper to introduce them here, because the observations on this subject, which prevail in our common works on grammar, seem to us very vague and inaccurate.

The method of procedure in teaching the Deaf-mute to pronounce, in succession, all those sounds which we have just considered, has been described, with so much perspicuity, by one who has had the most ample experience in the art, Dr Watson, that we cannot do better than give it in his own words.

"To effect this," says he, "and to habitude the pupil to associate the sound which he is learning to form, with the figure of the letter which is to be its representative, this is distinctly traced upon paper, or any convenient tablet, and he is made to look at it for a minute or two. He then, if of acute intellect, will look up with some anxiety in his countenance, as if he would ask what he is to do with it. The sound is then slowly and fully pronounced, and the learner made to observe, by his eyes, the position and motion of the external organs of speech, and to feel the vibration of the muscles of the larynx, by placing his finger upon the throat, carefully making him perceive the difference to be felt there between sound and silence. Having made these observations for a minute or two, he will seldom hesitate to attempt an imitation of what he has been observing, and that for the most part successfully. When the contrary is the case, nothing more is necessary than patient and good-natured perseverance; for he perceives that his failure has excited chagrin or disappointment in his teacher, he will make another effort with great reluctance. The sound once acquired, must be practised sufficiently to avoid any danger of losing it; for the greatest care must be taken all through his progress, never to proceed to a new sound till the preceding has become familiar, and unattended with doubt as to the manner of pronouncing it. A contrary practice would lead to endless vexation. A principal requisite is to keep the learner in good humour, and to make him think that he is doing well beyond expectation, and if anything is more discouraging than to put him back,"

On a comparison of the elementary Sounds of our language, and the various Modes of beginning and ending them, with the written characters by which they are represented, it will be easily seen, that our alphabet

Inconvenience from the imperfection of the common alphabet.
Dumb and Deaf.

is extremely imperfect. There is not a distinct letter for each simple sound, and for each mode of beginning and ending; but some sounds and modes are represented by one letter, and others by a combination of letters; sometimes one letter or combination is the mark of several different sounds or modes; and sometimes one sound or mode is expressed by several different letters or combinations. It is this, among other circumstances, which renders the pronouncing dictionary so necessary even to natives of our own country, and which occasions so much difficulty to the foreigner, and to persons in the situation of the deaf and dumb.

With a view not to perplex the pupil in his first lessons in elementary sounds, we would recommend, that only one mode of representing each sound be chosen at the commencement; the various other modes will be pointed out afterwards, when the uses of the different letters of the alphabet are fully exemplified. Thus the letter e may be selected, to represent the 4th Laryngeal sound in the first instance; and it may be afterwards shown, that the same sound is often expressed by a, ai, ay, ea, and ei.

After the scholar has acquired the power of pronouncing the sounds in their separate state, he is next to be instructed in the mode of combining them together into syllables and words. This, upon trial, will be found to be easier than might have been expected.

But the rapidity of the pupil's progress in speaking, and the ultimate proficiency at which he arrives, will be found to vary exceedingly in different cases. There are very few who can be taught to pronounce distinctly all the Laryngeal sounds; one or two of these being almost always unattainable. But it is not always the same sound that presents this difficulty to the learner; in one pupil it is the 1st, in another the 3d, in another the 4th, and so on. Nor is it easy to instuct the Deaf and Dumb in that gentle running of syllables into each other, that modulation of the voice, and that variety of accent and of pause, which are observed in the articulation of perfect and harmonious Speech. On these accounts, their pronunciation is, in general, accompanied with a kind of monotony and broken aspiration; if we may use this expression, which renders it somewhat unpleasing. In some instances, however, these defects exist in a surprisingly small degree; and we have ourselves seen boys who had only begun to articulate about three years before, whose softness and distinctness of utterance were altogether wonderful. At all events, it is gratifying to know, that, however imperfect their speech may be, when compared with that of others, it is, in most instances, sufficiently distinct to be quite intelligible to their friends, and even to strangers, after a little time; and consequently thus answers the leading purpose for which it is intended.

The same lessons by which the Deaf and Dumb are taught to articulate, and the same experience which gives them facility of Speech, instructs and improves them, also, in the power of interpreting by the eye the words of others. The quickness with which they come at last to exercise this faculty, is quite remarkable. "It is truly astonishing," says Dr Watson, "and would hardly be credited by any one who had not seen it, how readily deaf persons, who have themselves been taught to speak, catch words, and even long sentences, from the mouths of those who address them. Yet, in this sort of conversation, it is indispensable that the speech should be immediately directed to the spectator, (we must not call him auditor,) who must have an opportunity of observing every motion of the muscles, (as far as these can be seen externally,) and countenance, in order to make out the discourse. On this account, it is impossible for a deaf person to understand the conversation of a mixed company, a discourse from the pulpit, or a harangue to an assembly, where the speaker does not immediately address him." (Work quoted at p. 180, p. 121.)

We might add some very good observations, to the same purport, from the writings of De L'Epée; but we shall content ourselves, at present, with quoting only a few sentences, in which the Abbé, with characteristic benevolence, pleads for the observation of proper indugences towards the Deaf and Dumb, from all those who wish to address them in Vocal Speech: After stating the precautions to be observed in speaking to them, and remarking, what indeed often surprises the by-standers, that there is no necessity, in doing so, for the least emission of the voice, he observes, Il est vrai que tous ceux qui parlent vis-à-vis des sourds et muets, ne prennent pas toutes les précautions que nous venons d'expliquer, et c'est ce qui fait qu'ils ne sont pas aussi clairement entendus. Si les sourds et muets ne sentent pas autant qu'ils le pourraient, ce n'est pas leur faute, mais celles des personnes qui parlent devant eux, et qui ne prennent pas les précautions nécessaires pour se faire entendre.

En vain répondront on que ces personnes ne savent pas les dispositions qu'elles doivent mettre dans leurs organes, pour rendre sensibles aux sourds et muets les paroles qu'elles prononcent: sans doute elles ne le savent pas, et c'est pour elles une expédition de mystère; mais elles les mettent maladroitement (ces dispositions) dans leurs organes, sans quoi elles ne pourraient parler, et les sourds et muets (instructs) les apercevront toujours, tant qu'on omera, la bonne autant qu'il sera nécessaire, et qu'on parlera lentement en appuyant séparément sur chaque syllabe.

Nous avons cette complaisance pour les étrangers qui apprennent notre langue, et qui commencent à l'entendre et à la parler; et de leur côté ils font la même chose avec nous; que la leur nous est pas familier. Pourquoi n'en usurons-nous pas de même avec les sourds et muets nos frères, nos parents, nos amis, nos commensaux?" (Encyclop. Methodique Arts et Métiers, tom. v. p. 311. 4to. Paris, 1788.)

The last department of the education of the Deaf and Dumb which we proposed to consider, the Explanation of the meaning of words, is both the most interesting to the teacher, and the most agreeable to the pupil.

The method of procedure in this department, which has been practised by Dr Watson, accords, with a very few exceptions, so completely with that, which, after considerable reflection on this subject, we had ourselves set down as the best, that there is little left for us to do, than to state this method, as nearly in that excellent author's words as possible; and to recommend its adoption to all those who would attempt the instruction of the Deaf and Dumb.

In commencing the Explanation of the meaning of words, those terms ought, of course, to be selected at first, which are easiest to be understood. Now, of all the words of a language, the names of the objects that surround us admit of the most direct application, and they most naturally present themselves to begin with. The teacher, therefore, shews a word, by which some familiar object is called; as body, head, face, &c. and the scholar is made to copy it, on his slate, and is taught

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Familiar objects chosen first.

to pronounce it; he is then shown the object named, and made to point to it, while he pronounces the name; till he remembers the connection between the name and the thing sufficiently, to point out the object when shown the name, or to pronounce and write the name when shown the object. From the parts of the body, we proceed to the covering of it, and learn the names of the articles of dress, in the same manner. We then learn the names of the next most familiar objects; such as articles of furniture, chair, table, &c., always taking care to make perfect as we go on, and frequently going over all we have learnt, till every word becomes familiar in its articulation; orthography, and meaning.

Hitherto all is very easy. The objects, of which we have been learning the names, are within our reach, and about us in our apartment. But we are not always so confined; and we can hardly take a step beyond the threshold of our room, till we meet with something that we know very well by sight, but cannot name. We cannot remove it to our apartment to learn its name there; nor can we very conveniently carry our writing tablets with us, on all occasions.

Here another art, that speaks to the eye, comes to our aid: and the tool of the engraver, by furnishing us, in small compass, with the lines that bound the visual appearances of objects, in perspective order, enables us to keep their resemblances at hand; association recalling those properties which manifest themselves to our other senses.

With this view, Dr. Watson has had executed, for the use of his pupils, a series of engravings, representing, with all the requisite accuracy, upwards of 600 different objects. These are all comprehended in 80 octavo pages, and annexed to his work, which we have already so often quoted. The selection has been made with very great judgment, and cannot fail to be of the utmost use in the education of the Deaf and Dumb.

These engravings are accompanied with a printed vocabulary, consisting of the names of all the objects which the engravings represent, and also of all those words which are explained in the earlier lessons, before the engravings are had recourse to. This vocabulary is arranged in such a manner as to serve another very important purpose, namely, the explanation of a considerable number of general or generic terms. It is classified or divided into sections; at the top of each section is written, in larger characters, a general term; and under this are placed the names of various objects, to which this term is applicable: Thus,

**FISH.**

- Salmon.
- Cod.
- Flounder.
- Sprat.

**FLOWER.**

- Rose.
- Pink.
- Carnation.

**METAL.**

- Gold.
- Silver.
- Copper.

According to this simple and most obvious method, may all **general terms** be explained. We recommend, however, to Dr. Watson, that he should revise his vocabulary for this purpose. It seems to us susceptible of considerable improvement. The generic names are not philosophically chosen, and the illustrations of them are often not strictly accurate.

After having made the pupil familiar with this ex-

**Explanation of General Terms.**

**Explanatory catalogue of particular and general words,** we advise, &c., being disposed to deviate but a little from the plan recommended by this author, and to explain next to the scholar as many of those words which grammarians call **adjectives,** as can conveniently be illustrated by example: And when he has been sufficiently exercised in these, it seems to us, that we ought then to proceed to instruct him gradually in all the remaining kinds of words together; in verbs, and **adverbs,** and **prepositions,** &c., all in connection. For this purpose, we ought to begin with the illustration of short and simple sentences, and proceed by degrees to such as are longer and more complicated. Considerable assistance, we believe, may be derived at the commencement from the engravings by Dr. Watson already referred to; for many of these do not merely represent single and insulated objects, but objects in various relations to other objects, sometimes acting, sometimes acted upon; consequently, they are applicable to a variety of illustrations. All the Plates, from Plate 4. to Plate 23. inclusive, of his work, seem very well adapted to this end. We know not whether the intelligent author has ever applied them in this manner.

But in the more advanced stages, it will be found, that our illustrations must be derived entirely either from actual examples, or from the language of natural signs. Dr. Watson strongly inculcates the propriety of the teacher's learning this natural language from the Deaf and Dumb themselves; and the application which he afterwards directs should be made of it to the purposes of their own instruction, seems to us exceedingly judicious. "Every one," says he, "who would undertake the arduous task of successfully teaching the Deaf and Dumb, should closely turn his attention to the study of that language termed *natural.’" It consists of gesture and feature; in order to enable him to comprehend, as far as possible, the signs of his scholars. Of how much importance it is to a teacher of the Deaf and Dumb to understand their signs, will readily be apprehended, if any one will attempt either to teach or to learn a language, without having another, common to master and scholar. As it, for instance, an Englishman, understanding no language but his own, should attempt to teach it to a German, or rice verb. But never let any thing so chimical be thought of, as an attempt to turn master to the Deaf and Dumb, in the art of signing. Whatever others may say, I own, I have always found it best to become, in some measure, a learner, instead of teacher, of this mode of expression."—"How much more serviceable and useless," he afterwards remarks, "having just supposed a European endeavouring to new-model the scanty vocabulary of a South Sea islander)—"how much more serviceable and useless, is an attempt to methodize signs for the instruction of the Deaf and Dumb! Would it not be a more natural and rational mode of procedure for the teacher to begin, by watching the objects and occasions to which his scholar applies the words of his barbarous speech; that by knowing these he might gradually substitute the words of the language to be taught, using the **former** only as an introduction to the latter?
In the illustration of all those terms which express the various forms of human action, it is obvious, that the greatest advantage might be derived, from the aid of some intelligent assistant not affected with Deafness. If we may judge from the silence of those who have written on the education of the Deaf and Dumb, as to this important help, it does not seem to have been sufficiently employed.

In all that remains, we are inclined to follow Dr Watson implicitly. We perfectly agree with him, that it is altogether injudicious to load the memory of the pupil, at the outset, with those vague and subtle distinctions among words, with which grammarians occupy themselves so much and so unprofitably, and about which the pupils are still so much at variance with each other. It is quite enough, in the first instance, that they are taught, by examples continually diversified and repeated, to use words accurately, and as others use them. The metaphysics of grammar is a fitter study for riper years.

If we be correct in this opinion, it may be doubtful whether the education of those who are not Deaf, might not borrow some improvements from the mode of instructing those who are;—whether the young scholar's earlier years might not be more usefully employed in acquiring, by varied reading, writing, and conversation, greater copiousness, precision, and ease of expression, than in parsing nouns, with out the slightest regard to their spirit or meaning;—whether a few of those precious hours, which are sometimes wasted over the unprofitable pages of some modern Hermes, had not better be devoted to the nobler task of seeking out the strength of our language, and the best array of thought, in the pages of Shakespeare, and Milton, and Addison, and Hume.

After the pupil has proceeded thus far, Dr Watson recommends that he should go over his vocabulary again, with a view to learn the mode of defining words, that is of telling the meaning of one word by another, or by others. He prescribes this employment, not because he thinks he will better understand the words in his vocabulary, by being taught to define them, but because it affords an opportunity of enlarging it, by the introduction of synonymous words, and words that are derived in some way from those we are defining.

The scholar is now sufficiently far advanced to endeavour to acquire both amusement and instruction by reading; and having arrived at this point, Dr Watson imposes on him a new and most important task. To discover the progress he is making, and to assist him in the composition of sentences, he is required every day to furnish a certain number of lines, according to his capacity, from his own ideas. He is at liberty to choose his subject. He may relate what he has seen in his walk, or in his play-ground; he may unfold the stores of his memory, relative to more distant places and periods; he may ask questions, &c. His rude essays at expression are often curious, and require some skill in the language of pantomime to discover their meaning by his own explanations. This attained, it is put into correct, but easy language; he commits it to his memory thus corrected, and goes to work again, at his leisure hour in the evening, for next day, generally profiting considerably by the alterations it was necessary to make in his preceding essay.

This is an exercise which has been prescribed with the utmost success to the pupils of the Institution for the Deaf and Dumb in Edinburgh, by their teacher, Mr Kinimburch. He directs his scholars to address him in the form of letter; and in reading a considerable collection of these juvenile epistles with which Mr Kinimburch has favoured us, we own that we have often been exceedingly delighted with the simplicity and minuteness of the narrative.

Mr Kinimburch, with the same liberality with which he has permitted us to be spectators of his lessons at the Institution, has enabled us to present our readers with the following specimens.

The first is a letter from Charles Mackechnie, a lad of sixteen, who is in the third year of his education, and who can speak tolerably well. It describes a visit to the college court-yard, where a live Polar bear is at present kept, and to the Museum of Natural History.

"Dear Sir,

Edinburgh, March 1814.

Percival Clennell's father, and his brother, and gentleman, came to your house to the parlour, and he spoke to you. When (upon which) you told us, 'Come to me, you will change your coat,' and I went to the closet and changed my coat, and I went down stairs. And we went to the college; and his father met his mother in North Bridge, and we went to the college. And a gentleman went to the house, and took a key out, and came to us. And we went to the door, and he opened the door, and I wondered at a bear. And I saw a fence at the bear, and a lad took a pole, and he held it to the bear, and it roared. And he gave his father a pole, and he took and held it through the fence to take out flesh and bone, and it caught it, and it roared. And Percival Clennell and his brother were afraid of bear in the den, when we went from it to the door, and shut the door. And we went to a house, and man opened the door, and we went to the beasts and birds in the room.

And I saw an elephant's head by the bone, and young lion, and a little ostrich with a big egg, and cassowary, and serpents, and black monkey, and a deer had a long horn, and unicorn has a very long horn, and ducks, and shells, and marbles, and pebbles; and wild shark, and humming birds, and many clothes and shoes for Indian in cup-board hanging on the partition; and his father spelt tow the names of beast and birds.

I am, Sir, your affectionate pupil."

The next is by Joseph Turner, a lad of fifteen, who is also in the third year of his education, and speaks pretty well. It is entitled, a Visit to the Court of Session.

"Edinburgh, 11th Feb. 1814.

I, John Wilkie, and Charles Mackechnie, went to the Court of Session, and we saw a number of gentle men and advocates walking in the Court of Session. And a judge was sitting on a soft chair near the wall. He had a red gown on him, and a powdered wig on his head, and a large white band for a neckcloth on his breast. The advocates were sitting on the form before the judge, and they had black gowns on their bodies, and powdered wigs on their heads. One of the advocates got up from the form, and spoke out to the judge, and he hearkened to him speaking. When he sat down, the judge wrote in a book on the desk. Two advocates got up from the form, and one did not speak out; but the other advocate spoke out to the judge, and he lis-
DUMB AND DEAF.

Dumb and
Deaf.

Dumb and
Deaf.

Dumb and
Deaf.

It was a keeper of bees. My mother told me that I was a good boy to watch the bees flying round the bees- hives in the garden, in the summer or autumn of year 1808 and 1809. It was pleasant; for bees flew round the hives. She told me, that 'you must watch the bees flying round them, if they fly away in the air from the bees-hive.' When (upon which) I ran to my mother's house, and told her that the bees flew away in the air; and then we went to her garden, to see the bees flying in the air. I threw at the bees flying with clay, and my mother beat the iron pan with one iron stick; for the bees sat on the trees in my father's field, and they did not fly. She told me to go and bring another bee-hive, and a table. I went away to the house, and I took them to the field, and I gave them to her. And she put the bee-hive on the tree or the bush near the bees; and I saw she covered her face with a white veil, and she shaded them into the bee-hive from the bush with her right hand. In the evening, I and my father went to his field, and took the bee-hive to his garden, and put it on the broad stone; and we went into his house and rested ourselves.

Yours, &c."

These specimens have been copied literally from the manuscripts of the pupils, and have not undergone the slightest correction from the master. The general turn of the expression in some parts, but particularly in the last specimen, seems to us to bear a striking resemblance to the language of scripture; and yet we are assured, that all these compositions were written before either of the boys had begun to read from books of any sort.

In concluding the consideration of this department, we have only further to remark, that it is quite unnecessary to delay beginning the explanation of words, until a certain progress has been made in Writing, and Dactylogy, and Speech. It might even be entered on, before any of these departments are commenced. The connection betwixt objects and the written characters which represent them, can be established equally well, whether the pupil to whose organs of vision they are addressed, is or is not, able to speak or to write them. The explanation of words, therefore, ought to be begun as soon perhaps as the scholar enters on his education, although but a very small portion of his time can, at this early stage, be devoted to that object.

We have now gone through, with all the minutenes that appeared requisite to ourselves, and per-

haps with more than may have seemed necessary to some of our readers, the different departments of the education of the Deaf and Dumb. We shall be happy if our remarks are found calculated to afford the slightest assistance to any humane individual, who may have resolved to attempt the instruction of any Deaf and Dumb relation or friend, in the privacy and retirement of his own home. But we much fear that private tuition, in the case of the Deaf and Dumb, as well as in that of other children, can seldom be conducted with so much judgment as to afford advantages to the pupil, equal to the method of public instruction. We should wish, therefore, to regard all the early domestic lessons, which the natural affection of a parent may lead him to bestow on his Deaf and Dumb child, in the light merely of preparation for his introduction into some public school.

There is much reason to regret, that the public institutions for this purpose in Great Britain are so few in number. We are acquainted only with two that have yet acquired any reputation, one in London, and the other in Edinburgh.

The former is entitled, the "Asylum for educating the Deaf and Dumb Children of the Poor," and was instituted in 1792. This asylum contains at the present time, if we are not misinformed, about 100 pupils; and these are fortunate enough to have for their instructor, the very judicious person whom we have had occasion so often to quote, Dr Joseph Watson. It does not, however, admit any children on the charitable foundation until they are nine years old. "The reason for fixing upon this age," says Dr Watson, "was not any idea that it was the earliest at which regular education could be advantageously begun; but five years being deemed, generally speaking, sufficient to accomplish that course of instruction thought most essential to children, destined to earn their bread by the labour of their hands, and fourteen being the earliest age at which they could be apprenticed, it was judged best, for the economical purposes of the institution, not to receive them before the age of nine years."

That he may not be misapprehended, Dr Watson afterwards states precisely what he understands by an education most essential to deaf children of the class mentioned. "I deem it essential," says he, "that they should have such a knowledge of language, as to enable them to express their ideas on common occasions; to understand the commands or directions it may be necessary to give them in ordinary cases, &c.; to read with intelligence the precepts, the examples, and the promises, which are contained in the scriptures, particularly the New Testament; that they should write a good hand, spell correctly the words they use, and understand the principal rules of arithmetic. When I say that these acquisitions may be attained in five years, I mean to state that as the shortest time, even where the capacity of the learner is good."

The "Edinburgh Institution for the Education of Edinburgh the Deaf and Dumb Children of the Poor," was established only in 1810. Its objects are precisely the same as those of the London Asylum. It does not admit children before eight, nor after fourteen years of age. It

* A marble statue of the Lord President Forbes.
† Our readers will recollect that this practice is at least as old as Virgil:
    "Hac tu juva adspicer, amicus,
    Fut temetis scilicet, et certanea ignobilem gens.
    Tumnitusque cie, et Matris quae symbala circum."

    GEOR. LIB. IV. V. 63.
already contains 55 pupils, and yet we are persuaded that its advantages only require to be more generally known in this part of the island, to secure to it still more of the public favour than it has already enjoyed. We can speak from our own observation, as to the justice done this institution by the teacher Mr Kinniburgh, who is a person in every respect well qualified for the important and laborious duties of his situation.

We shall conclude this article with a few historical remarks.

If the authorities to whom we have found reference, relative to this point, be correct, a Spanish Benedictine monk, of the convent of Sahagun in Spain, named Pedro de Ponce, who died in 1534, is the first person who is recorded to have instructed the Deaf and Dumb, and taught them to speak. Ambrosio Morales, the contemporary and friend of this Pedro de Ponce, in a work on the Antiquities of Spain, which seems to have been written about 1583, speaks of him thus: "Pedro de Ponce has taught the Deaf and Dumb to speak with singular perfection. He is the inventor of that art. He has already taught, in this manner, two brothers and a sister of the Constable; and is at present occupied in instructing a son of the Governor of Aragon, who, like the preceding, has been Deaf and Dumb from birth. What is most surprising in this art, is, that his pupils, notwithstanding their deafness, speak, write, and reason very well. I have a paper belonging to one of them; Don Pedro de Velasco, the brother of the Constable, in which he tells me, that it is to Father Ponce he is indebted for being able to speak." (Quoted by Don Emmanuel Nunez de Taboada, in a note to p. xxxviii. of Pref. to Anatomie et Physiologie du Systeme Nerveux en General, par J. J. Gall et G. Spurzheim, vol. 1, 4to, Paris 1810.) Valles, also a contemporary and friend of De Ponce's, in a work entitled, De Sacra Philosophia, published about 1588, has this expression respecting him: "Petrus Pontius, Monachus Sancti Benedicti, amicus meus, qui, res mirabilis! natos surdos docebat loqui." In confirmation of these testimonies, Don Emmanuel Nunez, a Spaniard, mentions that, he has read in the register of deaths of the Benedictine Convent of San Salvador de Ona, where Pedro de Ponce passed the greater part of his life, the following note: "Obiit omnivit in domino, frater Petrus de Ponce, hujus demus benefactor, qui, inter ceteras virtutes, quae in illo maxime fuerunt, in hac praecipe floruit, ac celeberissimo tuto urbe fulitus habitus, sollicitus, Mutus Loqui Docendi. Obit anno 1589 mense Augusto." (Work quoted above, p. xl.) The same person states, too, that other Spanish authors, such as Lopez and Castaniza, some of them contemporaries of De Ponce's, also speak of him in the highest terms, and assure us that he not only taught his pupils to speak, but instructed them in every science which it is possible to teach to those who enjoy all the senses.

In the anonymous translation into English of the Abbé de l'Épée's Method of Educating the Deaf and Dumb, (8vo, London, 1801,) the translator, in a preface, makes the following remark: "Of former instructors, he who seems to have obtained greatest notice was Bonet, a priest, Secretary to the Constable of Castile, whose younger brother had lost the sense of hearing when two years old. The difficulty of procuring instruction for him creating much distress in the family, Bonet, qualified for the province of tuition by expert knowledge and uncommon learning, undertook the care of his education; in which he succeeded beyond every hope. The system which he formed on the occasion was printed at Madrid in 1626, under the title of Reductión de las Letras, y Arte para enseñar a hablar los Mudos, dedicated to Philip III. and accompanied, according to the custom of the age, with encomiums in verse and prose, from poets and philosophers. The author is said to have been afterwards in the service of the Prince of Carignan, and to have continued many years to teach persons to whom the misfortune of Deafness made his lessons needful."

Nunez, however, to whom we have already referred, maintains, that Juan Paulo Bonet must have derived his knowledge and his method regarding this subject, entirely from De Ponce; for Bonet was secretary to the Constable at the very time De Ponce was employed in teaching the Constable's two brothers and sister. (Work quoted above, p. xli.) There is, therefore, some obscurity connected with the history of this work, which it will not now, perhaps, be easy to remove. We have neither seen the Treatise itself, nor any account of its contents; but we presume it has considerable merit, as we observe that it was much consulted by De l'Épée, when he first began to teach his pupils to speak.

The translator of De l'Épée's Method, mentions a Dr Bulwer's treatise as having been published by Dr John Bulwer, an English physician, in 1648, entitled, Philosophus, or the Deaf and Dumb Man's Friend. We have not seen this work either; but we believe we can form some idea of its value, from two other short publications by the same author, which appeared in 1644, the one entitled Chirologia, or the Natural Language of the Hand, and the other, Chironomia, or the Art of Manual Rhetoric; in neither of which are there even absurdi ties sufficient to reward their perusal. We presume it is the same Bulwer who wrote a curious book, entitled, Anthropomorphosis; in which he treats of the various shapes and dresses, which men have assumed in the different ages of the world.

In 1653, a work of great labour appeared by Dr Wallis's Writings and Prac- tices, entitled Grammatica Linguæ Anglicæ; and to this was prefixed, by the same author, a treatise of considerable acuteness and originality, De Logueta, sive de Sonorum omnium loquetarium formatione. In consequence of these investigations, his attention seems to have been directed to the subject of the education of the Deaf and Dumb. A very interesting letter of his to Mr Boyle, dated from Oxford, March 1692, is inserted in the Philosophical Transactions for July 1707; wherein he informs Mr Boyle of his having just entered on the task of endeavouring to teach a person to speak and to understand a language, who had lost his hearing, and consequently his speech, when about five years old. He states the considerations which induced him to attempt this work, and the wish he has to conduct it; and nothing can be more sound or judicious than all his remarks on this subject. "The task itself," says he, "consists of two very different parts; each of which doth render the other more difficult; for, beside that which appears upon the first view, to teach a person who cannot hear, to pronounce the sound of words, there is that other, of teaching him to understand a language, and know the signification of those words, whether spoken or written, whereby he may both express his own sense, and understand the thoughts of others: without which latter, that former were only to speak like a parrot, or to write like a scribener, who, understanding no language but English, transcribes a piece of Latin, Welsh, or...
At the conclusion of the letter, he mentions the progress he had already made, which he pronounces to have exceeded his expectations. His pupil had been with him only about two months; and yet in that short time he had got over the greatest difficulties of both departments: there was hardly any word which (with deliberation) he could not pronounce; and he had already learned the meaning of a considerable part of those English words which are in most frequent use.

About thirty-six years after this, a letter of Dr Wallis's was printed in the Philosophical Transactions, (Phil. Trans. 1698, p. 353.) in reply to one from Mr Thomas Beverly, in which that gentleman had requested his advice, relative to the education of five Deaf and Dumb children. In this letter Dr Wallis mentions, that, four or five-and-thirty years before, he had taught Mr Alexander Popham, who had been born Deaf, to speak distinctly, and to understand a Language so as to express his mind tolerably well by writing, and to understand what was written to him by others Prior to this, too, he states his having taught Mr Daniel Whaley; the same gentleman, we presume, whose education he had just entered upon, when he wrote to Mr Boyle in 1662. "Some other Deaf persons," he also adds, "I have not attempted teaching them to speak; but only so as (in good measure) to understand a language, and to express their mind (tolerably well) in writing. Who have thereby attained a much greater measure of knowledge in many things, than was thought attainable to persons in their circumstances; and become capable (upon further improvement) of such further knowledge as is attainable by reading."

After stating shortly the mode of proceeding in teaching the Deaf to speak, and referring to his Treatise de Loquela, with that view, he observes: "This is, indeed, the shorter work of the two, (however looked upon as the more stupendous.) But this, without the other, would be of little use. For, to pronounce words only, without a parrot, without knowing what they signify, would do us but little service. The other part of the work (to teach a Language) is what you now enquire about." He then goes on to detail the method he had followed in this department with success, and which reflects equal credit on his acuteness and good sense.

In the Philosophical Transactions for January 1668, p. 602, there is an account of a small Tract which was published the preceding year, both in Latin and German, by F. M. B. V. Helmont, entitled Alphabetum Naturae. In the first dialogue of the first part, the author is said to treat "of the motions and configurations of the mouth of man; and how a man born Deaf; and consequently Dumb, may come to understand, both them, and by them, the mind of him that forms them; where it is observed, that a man born Deaf is not altogether destitute of all motion of his tongue, and that he may be taught to understand others by the motions of the mouth and tongue, much after the manner as others are taught to read. To which is annexed, a method suitable to that principle, of teaching Deaf and Dumb men to speak; together with an example of a musician, who being altogether Deaf, and weak-sighted withal, was, by the author, brought so far in the space of three weeks, that he was able to answer to all that was spoken to him, provided it were done slowly, and with a well opened mouth; who also afterwards by himself, as soon as he had by this very way learned to know the letters, and to read, did, by confronting only the German and Hebrew Bibles, learn in a short time the Hebrew tongue so well, that now he understands the whole Hebrew Bible."

The subjects of the remaining parts of this work, all relate to Speech or Language; but they seem to be treated in a very whimsical manner.

In 1669, Dr Holder published his Elements of Speech, with an Appendix concerning persons Deaf and Dumb. The appendix contains an account of the method he employed in the education of a Deaf and Dumb person, who was recommended to his care in 1659, and whom he taught successfully to speak. The whole work is rather tedious and obscure.

The translator of De L'Epée's Method, (Pref. p. vii.) refers to a work printed in 1670, entitled A Treatise concerning those that are Born Deaf and Dumb; and bearing the name of George Sibstoffe, as its author. It is said to treat of the tuition of the Deaf and Dumb, rather in a loose and general manner, as a subject of speculative enquiry; but we have never seen it.

The next work, in point of date, relative to this subject, is a small treatise by George Dalgarne, published at Oxford in 1680, under the following title: Dulas-calopochus, or the Deaf and Dumb Man's Tutor, to which is added, a Discourse of the nature and number of Double Consonants: Both which Tracts being the first (for what the Author knows) that have been published upon either of the Subjects.

This treatise is purely speculative. The author does not profess to have actually taught the Deaf and Dumb; he only points out their capability of being instructed, and lays down the general principles according to which he conceives that their Education ought to be conducted. It is obvious, however, not only from the title-page, but also from the whole tenor of his treatise, that he was altogether ignorant of the successful labours of Wallis, and Holder, and the other authors, to whom he has referred, as preceding him in this department; a circumstance for which it is not easy to account, when we consider that he had lived at Oxford for upwards of twenty years prior to the publication of his book.

The only media he conceives, by which instruction can be effectually conveyed to the Deaf and Dumb, or by which they can be enabled to communicate their thoughts to others, are Writing and Manual Speech. He has no doubt that a Deaf Man may be taught to speak vocally; but he seems to think that this sort of speech will always be so imperfect in him, that it is not worth his acquiring. As to such a person's being able, by the eye, to understand the speech of others, he endeavours to prove that that is impossible, by an argument à posteriori, as he calls it, delivered in the regular form of Syllogism.

In consequence of these false views, his attention seems to have been chiefly directed to the improvement of the department of Dactylogy; and after much search and many changes, he fixes on a Finger-Alphabet performed with one hand, which he regards as a very important discovery, and which he describes minutely in his eighth Chapter.

The parts of his treatise, however, which appear to us to possess most merit, are those he entitles the Deaf Man's Dictionary, and the Grammar for Deaf Persons. The general principles according to which he proposes, in these, that the Deaf and Dumb should be instructed in the Meaning of Words, are quite correct; and accord completely with those which Wallis
had laid down in his letter to Boyle, and by which he had actually regulated his practice nearly twenty years before. His method, however, when considered in detail, is inferior to that of Wallis, both in arrangement and perspicuity.

The treatise, taken as a whole, is spirited and amusing; and is, obviously, the production of an original mind.

About the year 1690, a Swiss physician, named John Conrad Amman, was requested to undertake the education of a young girl at Haerlem, who had been born Deaf and Dumb. He succeeded so well in this task, that, in two months, she could not only read distinctly, but could write down whatever was spoken to her; and at last could support a conversation on any subject, and reply with promptness to those who interrogated her; hearing, as it were, by the eyes.

He published an account of the method he employed on this occasion, in 1692, entitled, Surdes Logues. But after having occupied himself occasionally, as it would seem, in this species of education, for several years, during his residence as a physician at Amsterdam, he published this essay under an enlarged form in 1700, entitling it Dissertatio de Loguca. In this Dissertation he treats, not only of the means by which the Deaf and Dumb may be taught to speak, but of Voice and Speech in general, and of the nature and treatment of certain impediments or imperfections of Speech. The treatise is inferior, we think, in all its branches, to the writings of Wallis on the same subjects, but superior to the work of Holder. The author does not seem to have been aware when he composed it, that so much had been written before him relative to the Education of the Deaf and Dumb. He only became acquainted with what Wallis had done in this department, when his Dissertation was printing.

After this period, the number of teachers of the Deaf and Dumb seems to have increased very rapidly on the continent.

In 1749, the Royal Academy of Sciences at Paris, report very favourably, of the exertions of a M. Pereire, who seems to have been employed for some time previously, in educating the Deaf and Dumb in that city.

They state, that M. Pereire had presented to the Academy, two young persons born Deaf and Dumb, whom he had instructed to understand whatever was addressed to them, either in writing or by signs, and to reply either in writing, or vivâ voce; that they read and pronounced all sorts of expressions in French; that they were acquainted with Grammar and Arithmetic; and knew a little of Geography: That Pereire, in addressing his pupils, employed either Writing, or a Manual Alphabet; but that he hoped to teach them, in time, to comprehend what was said to them, merely by the motions of the lips; that the progress of his pupils shewed the goodness of his Method of Instruction, which, however, he kept a secret; and that the Academy conceived they could not too much encourage M. Pereire to cultivate so useful an art. (See Hist. de l'Acad. Roy. des Sciences, 1749, 8vo. p. 209.)

It does not appear that Pereire ever published a systematic account of his mode of Instruction. But De l'Epee asserts (with what truth we know not) that he had profited by the labours of Wallis, and Bonnet, and Amman. (p. 277, of Work quoted at p. 187.) A well written memoir of his, however, will be found in the 5th volume of the Memoires Présentés à l'Académie Royale, (4to, Paris 1768,) in reply to one inserted in the same volume by M. Ernauld. In this memoir, besides vindicating his claim to the discovery of a very curious fact relative to the Deaf and Dumb, namely, that they may be taught to distinguish sounds to a certain extent, merely by the impressions produced on their skin by the breath of the person speaking, Pereire points out several very important distinctions in the degree of Deafness, with which different Deaf-mutes are affected.

M. Ernauld, who called forth this Memoir from Pereire, undertook the education of two Deaf-mutes at Bordeaux in 1756, and the following year they appear to have been presented to the Royal Academy of Sciences. But there is every reason to suspect, that he had derived hints of the method he pursued from Pereire, and that he acted unaidingly towards this person. The Memoir, besides some general observations, contains an account of his successful progress with a third pupil.

From the report of the Royal Academy, it would appear that, prior to Pereire's lessons, Emmanuel Ramirés, Pierre de Castro, and Father Vanin, had been employed in teaching the Deaf and Dumb in Paris; and Ernauld mentions, in 1768, that Rosset, Professor of Theology at Lausanne, and Rousset, residing near Nimes, had then devoted themselves to this occupation. None of these individuals, however, seem to have communicated either their methods, or the results of their exertions, to the public.

No person, perhaps, has ever conducted the education of the Deaf and Dumb, in all its branches, with more distinguished success, than Mr Thomas Braidwood. Mr Braidwood was the first person who kept a regular academy, for this purpose, in Great Britain. He entered on the profession, with a single pupil, at Edinburgh, in 1764; but the number of his scholars increased with his reputation, and he continued teaching a large school, for many years, in this city, and afterwards at Hackney, near London, until his death in 1806. Innumerable testimonies might be produced as to the great proficiency of his scholars; but we shall content ourselves with selecting one or two sentences from Dr Johnson on this subject, who visited Mr Braidwood's academy, while in Edinburgh, on his return from the Western Isles, in 1773.

"There is one subject of philosophical curiosity," says he, "to be found in Edinburgh, which no other city has to show; a college of the Deaf and Dumb, who are taught to speak, to read, to write, and to practise arithmetic, by a gentleman whose name is Braidwood. The number which attends him, is, I think, about twelve, which he brings together into a little school, and instructs according to their several degrees of proficiency."

"—This school I visited, and found some of the scholars waiting for their master, whom they are said to receive at his entrance with smiling countenances and sparkling eyes, delighted with the hope of new ideas."

"—The improvement of Mr Braidwood's pupils is wonderful. They not only speak, write, and understand what is written, but if he that speaks looks towards them, and modifies his organs by distinct and full utterance, they know so well what is spoken, that it is an expression scarcely figurative to say they hear with the eye."

He afterwards adds, in his characteristic manner: "It was pleasing to see one of the most desperate of human calamities capable of so much help; whatever enlarges hope, will exalt courage; after having seen the
Dumb and Deaf.

Dr Watson.

Deaf taught arithmetic, who would be afraid to cultivate the Hebrides?" (Journey to the Western Isles.)

It is said that Mr Braidwood was restrained from laying his system before the public, solely by a persuasion that he could not explain it in words with sufficient precision to enable any one to act upon it. But we fortunately possess the means of appreciating its merits fully, in the work of his relation and able assistant Dr Watson; who, it is generally understood, teaches according to the principles of his master. That work, to which we have already referred so frequently, is, without any exception, the best that has yet appeared relative to the education of the Deaf and Dumb. How far Mr Braidwood was acquainted with the writings of Wallis we know not; but his general views are the same. Dr Watson seems to have methodised and improved the systems of both.

De L'Epee.

All this had been done and written, before the name of De L'Epee was known. But chance now directed the attention of this reverend person to the education of the Deaf and Dumb; and he had soon the good fortune, not only to acquire a much more general reputation throughout Europe, than ever had been enjoyed by his predecessors or cotemporaries; but even to be looked on with admiration by many, as the first philosopher who had discovered the possibility of illuminating the minds of this unfortunate class of persons.

The Abbé happening to go into the house of a lady in Paris, who had two daughters that were born Deaf and Dumb, found her disconsolate for the death of their preceptor Father Vanin. He was touched with pity for their condition, and went home reflecting how he could best supply the place of their teacher. Soon after, he returned; put some of his reflections to the test of experiment; was satisfied; and resolved to become their preceptor himself. Thus began his philanthropical exertions as an instructor of the Deaf and Dumb; and this commenced his fame.

The English translator of his Method informs us, (Pref. p. viii.) that the Abbé instituted a seminary, in which he received as many of the Deaf and Dumb, as he could superintend, and formed preceptors to teach those in distant parts. "The number of his scholars," says he, "grew to upwards of sixty; and, as the fame of his operations extended, persons from Germany, from Switzerland, from Spain, and from Holland, came to Paris to be initiated in the method he practised, and transfer it to their several countries."

"The expenses," this author observes afterwards, "attending the seminary which he established, were wholly defrayed by himself. He inherited an income, as M. de Bouilli informs us, amounting to about 14,000 livres, (nearly L. 600 sterling) of which he allowed 8000 for his own person, and considered the residue as the patrimony of the Deaf and Dumb, to whose use it was faithfully applied. So strictly he adhered to this appropriation, that in the rigorous winter of 1788, when in his 65th year, and suffering under the infirmities of age, he denied himself fuel rather than intrust upon the fund he had destined them. His housekeeper having observed his rigid restriction, and, doubtless, imputing it to its real motive, led into his apartment forty of his pupils, who besought him, with tears, to preserve himself for their sakes. Having been thus prevailed on to exceed his ordinary expenditure about 300 livres, he would afterwards say, in playing with his scholars, "I have wronged my children out of a hundred crowns."

In 1776, he published a work in French, entitled Institution of the Deaf and Dumb by the way of Methodical Signs; and, in 1784, a new edition of this, much altered, appeared under the title of, La véritable manièr e d'instruire les sourds et muets, confirmée par une longue expérience. It is this last work which he introduced into the Encyclopédie Méthodique, under the article Muets et Sourds, (part referred to at p. 187,) and which was translated into English, anonymously, at London, in 1801.

He continued to teach at Paris, with unremittent perseverance, until 1790, when he died, aged 67.

After the great and almost universal celebrity which the Abbé seems to have acquired, we shall hardly be listened to when we affirm, that the system which he taught was utterly useless. Yet that this was the case, is but too obvious from the works which he himself has published,—from the criticisms made on his method in the work even of his pupil and successor Sicard,—and from his own confidential letters respecting it, which Sicard has presented, along with these criticisms, to the public.

When he first began his career as an instructor of the Deaf and Dumb, he seems to have been entirely ignorant that Pereire was then teaching, and had taught, for several years at Paris; or that this species of education had ever been the subject, either of speculation or practice, at any former time, or in any other country; and he confesses that it never occurred to him to be practicable to teach his pupils to speak. But the works of Bonnet and Amman soon became known to him; and, guided by their direction, he seems to have succeeded in bestowing the gift of Speech on several of his scholars. Latterly, however, he appears to have neglected this branch very much; whether from a mistaken idea of its inutility, or really (as he professes) from his inability to undergo the labour of teaching a number of pupils at once, is very doubtful. In the part of his book which relates to this subject, he pretends to no more, than to have added a few reflections of his own, to what he had found in Bonnet and Amman.

But the peculiarity of his method of education, and the object to which every other seems to have been sacrificed, was his system of "Methodical Signs." This was an extremely complicated Language of the Hand, representing, not single letters as in the common Manual Alphabet, but whole words; and the sole occupation of the pupil seems to have been, acquiring this language, and converting Methodical Signs into Writing, or Writing into Methodical Signs, according to the dictation of the master.

It is only necessary to reflect, however, that this system of signs was entirely peculiar to De l'Epee, to perceive that it must have been altogether useless to his pupils as soon as they passed from school into society; and that it was an absurd and inexcusable waste of time to teach them a complicated artificial language, which was perfectly unintelligible to the whole of the rest of the world. It is true, indeed, that while the Abbé instructed his scholars in these Methodical Signs, he professes also to have taught them the meaning of the words which they were intended to represent. But whatever may have been his wishes or his professions on this subject, the fact is, that the stock of words which they actually understood, seems to have been exceedingly small. He appears to have established in their minds, merely an association between Manual Signs and Written Characters; neglecting or failing to accomplish a connection of infinitely more importance, that between
Written Characters and Things. They appear not to have been trained to any original exertion of intellect; the composition of a sentence even of moderate length in French, was a task of which they were incapable; in all those public trials before kings, and princes, and philosophers, of which Europe has heard so much, the pupils had question and answer alike dictated to them by their teacher, without their knowing in general the real meaning either of the one or the other; and those parents who fondly flattered themselves, that when their children returned from the instructions of De l'Epée, they would be enabled to enjoy the interchange of ideas with them through the medium of writing, were mortified to find that they knew not how to ask a single question themselves, and that to all those that were addressed to them, they could only answer by a yes or a no.

These imperfections in the Abbé's system do not seem to have entirely escaped the notice of those who visited his public lessons, or the lessons of persons who had been taught under him. His method was introduced by Pereire and Nicolai; and although an attack made on it by Heinich, a teacher of the Deaf and Dumb at Leipsic, called forth a decision of the Academy of the Northumber in favour of the Abbé, yet we do not think that that learned body acquired much reputation by their defence.

Two documents have been preserved by Sicard (who, certainly, has not been over-greatful of the reputation of his master, in presenting them to the public), which show, in a very unequivocal manner, how very limited De l'Epée's notions were as to the extent to which the education of Deaf and Dumb persons might be carried; and clearly develop the real object (we had almost said the whole trick) of that system, according to which so many were taught, and by which so few profited.

Sicard, in conducting the education of a Deaf and Dumb pupil at Bordeaux, had communicated to the Abbé an account of his progress, and of some deviations which he had ventured upon from the Abbé's method. De l'Epée replied in a letter, from which we translate the following extract.

"I applaud sincerely your success, my dear colleague, (I set you the example, I wish no more to be called master), but I fear much that you are becoming the dupe of an ambition to make your pupils metaphysicians. Don't imagine that they will ever be able to express their ideas in writing. Our language is not theirs; theirs is the language of signs. Content yourself that they know how to turn ours into theirs, just as we ourselves translate foreign languages, without knowing or caring how to express ourselves in them. Is it not enough for your glory, to be destined to partake of mine? And what more is necessary to secure this, than that your pupils, like mine, should merely know how to write, to the dictation of signs?"

Another letter, written a few weeks afterwards, is still more explicit. The following is a translation of it.

"What, my dear colleague, your pupils not yet know how to write short sentences, to the dictation of signs! What are you doing? What are you trifling about? You wish absolutely to make writers, when our method is in fact capable only of making copyists. You have assisted at all my public lessons; have you ever seen that the spectators required of my pupils what you expect of yours? If questions have been occasionally proposed to them to answer, these have been short familiar interrogations, which are always the same; and yet you have seen that the greatest persons of the court and the city, and even foreign princes, have asked no more. Take my advice, my dear colleague; renounce your pretensions, which smack a little of the 'Garonne'; and satisfy yourself contentedly with the portion of glory which you see me enjoy. Teach your pupils, without delay, declension and conjugation; teach them the signs of my dictionary of verbs; teach them to construct parts of sentences, according to the table of which you have a copy, without flattering yourself that your scholars will ever express themselves in French, more than I can express myself in Italian, although I can translate that language very well." (p. 484 of Work quoted at p. 183.)

We have done with the Abbé de l'Epée. That he was industrious, and ingenious, and singularly benevolent, is beyond all question; but it seems to us equally clear, that, as a teacher of the Deaf and Dumb, he was greatly inferior to most of his predecessors, in the soundness of his principles and the utility of his practice. We think too, that we are fully justified in adding, that, in order to secure that glory which he loved, he seems occasionally to have indulged in an empiricism which it became him to despise.

There is an essay on the "Method of teaching the Deaf and Dumb to Speak," by Dr William Thornton, in the third volume of the Transactions of the American Philosophical Society (4to, Philad. 1793, p. 310); but it contains nothing that may not be found in the works of preceding authors. The treatise to which it is appended, on the Elements of Written Language, contains observations which have a much better claim to originality.

The latest work on the Deaf and Dumb, is that of the Abbé Sicard. Sicard, after having been for some time the assistant of De l'Epée, first employed himself as a teacher at Bordeaux. But on the death of his master at Paris, he was appointed to fill his place, and he now conducts a very numerous seminary in that city. Although he still continues to trammel his pupils with the system of Methodical Signs, he has so far improved upon the method of his predecessor, that he instructs them fully and correctly in the meaning of words, and teaches them to compose for themselves. Many of them, we have understood, are extremely intelligent; but why he does not teach them Speech, we know not. If, however, the method which he pursues in instructing Massieu at Bordeaux, and the detail of which constitutes his work, be that which he adopts in general towards all his pupils, we must say, that his system is one of the most tedious, intricate, and metaphysical, that it is possible to conceive. They who have profited by the simplicity and good sense of Wallis and Watson, will not be readily prevailed on to wade through many pages of the declamation and useless subtlety of Sicard. (q. s.)

DUMB, DEAF, AND BLIND. For an account of an interesting young lad, born in this unfortunate condition, see MITCHELL.

DUMBARTON, a town of Scotland, situated at the confluence of the rivers Clyde and Leven, and within the parish and county of the same name. Dumbarton (the fort of Britons) was the ancient name of the castle, which has been a place of strength from the earliest times, and was long deemed impregnable. It is a bold and insulated basaltic rock, rising to a great height out of the sands on the north side of the Clyde.
DUMBARTONSHIRE, a county in Scotland, (formerly Lennox,) consists of two parts, separated from one another. The western is the larger, being about 40 miles in length from north-west to south-east, and where the broadest, about 12 in breadth from north-east to south-west. The other division is about 12 miles in length from east to west, and four in breadth. The former is bounded on the north by Perthshire, on the west by Argyllshire and Loch-long, on the south-west by the Clyde, on the south by Lanarkshire, and on the east by Stirlingshire; the latter is encircled by Lanark and Stirlingshires. The county lies between 55° 58' and 56° 23' of north latitude, and between 3° 55' and 4° 53' of west longitude. No accurate surveys have been made of the superficial extent of this county; but from the most plausible computations, it is stated to be about 230 square miles, containing 147,500 English acres, or nearly 116,000 Scotch acres, exclusive of lakes and arms of the sea within its boundaries. This shire takes its name from Dumbarton, the county town.

The county of Dumbarton was formerly a part of the regality of Lennox. Since the abolition of heritable jurisdictions, it forms a sheriffdom by itself, and it sends a member to parliament. This county is divided into 12 parishes. It is within the commissariot of Glasgow; and the civil and ecclesiastical jurisdictions in it are the same as those common to the rest of Scotland.

The county of Dumbarton embraces every variety and every beauty in the scenery of Scotland. Of its charms, in this respect, no adequate description can be given. The most conspicuous object of admiration is Loch-lomond. This fine lake is 30 miles in length, and in some places eight or ten in breadth; its surface is above 20,000 acres in extent, its greatest depth 100 fathoms; the bottom, to the depth of five feet, being composed of fine mud mixed with mica. It contains 30 islands of various dimensions, one of which extends to about 150 acres. These are scattered on the bosom of the lake, some of them scarcely appearing above it, and others swelling to a greater height; some of them tufted with wood, and others more sparingly supplied with foliage. The well-wooded banks, the soft and verdant fields, and the rugged and towering mountains which rise on the northern verge of the lake, produce the most picturesque combination of beauties in landscape on which the imagination can dwell. One of the islands, Inch Murrin, feeds about 300 deer. On the west end of it, the ruins of an old castle, an ancient residence of the Earls of Lennox, stands; and near it the Duke of Montrose, in 1793, built a neat hunting box. A gamekeeper and his family are now the only inhabitants. The north end of the loch is never frozen, but towards the south it has often been; and after great floods it has been known to rise six feet higher than usual. In 1755, when there was an earthquake at Lisbon, Lochlomond was agitated, and rose and fell for some time above and below its ordinary level. Its surface is sometimes ruffled with undulations when there is no wind to produce such an effect.

This county, from the latest and best information, Population, contains about 21,759 souls. In 1756, it was said to contain 13,253; and, when the Statistical Account was published (1790-8), 17,745; being an increase, in 54 years, of 8490. This increase is to be ascribed chiefly to the establishment of numerous manufactories. The number of landed proprietors is 149; the valued rent is L33,382, 7s. 8d. Scots; the real rent, as nearly as can be ascertained, L56,000. No proprietor of land perhaps draws an annual revenue from his property above L3000; and none of them have very large estates. The farmers are, generally speaking, possessed of very moderate skill, and very little capital; and these facts
DUMBARTONSHIRE.

being stated, we need hardly add, that agriculture is not in its most improved state. The lands, however, are let on leases, and improvements are gradually creeping in, although they must struggle at once with the poverty and the prejudices of the inhabitants, in whose character there is nothing very prominent to distinguish them from that of the adjacent counties.

The only river of any consequence which can be said to belong to Dumbartonshire is the Leven. This stream is the outlet of Lochlomond, after leaving which it runs with a rapid current for about five miles through a fine valley, till it joins the Clyde at Dumbarton castle. In spring and autumn there is an imperfect navigation on the Leven for lighters and small craft, which float down the stream, and are towed by horses in an opposite direction. The other rivers are Foon, Luss, Finlay's Douglas, and Falloch, all which are mountain torrents, falling into Lochlomond and Laggie.

In the parishes of Kirktunlloch and Cumbernauld, and also in the eastern part of the larger division of the county, the predominant soil is what in Scotland is generally called till; a shistose clay mixed with a few small stones, impervious to moisture, and generally incumbent on sand-stone. Along the banks of the Clyde, in the parishes of Dumbarton and west Kilpatrick, there are many fields of a rich black loam, of the most fertile quality, though suffering from moisture on account of their being but little elevated above the surface of the river. Some fields of nearly a similar description are to be found on the banks of the Endrick, in the parish of Kilmarrock, and of Kelvin near Kirktunloch. On the river Leven, and to the northwest of that stream, the arable land is, for the most part, of a light gravel, mixed on the seashore with shells and other marine productions, and covered with a thin stratum of vegetable soil. The extent, however, of arable ground of every description is inconsiderable, as by far the greatest part of the county consists of lofty mountains, incapable of any thing like cultivation. In the parish of Arroquhar, which is more than twelve miles in length and four in breadth, and consequently must contain 24,000 acres, there are not 200 arable, or capable of being made so. This parish is indeed singularly mountainous, and rises in some places to the height of no less than 3000 feet above the level of the sea; but the parishes of Rew, Roseneath, and Luss, are also, for the most part, composed of mountains, and have comparatively but a small proportion of arable or low pasture. In Cardross and Bonhill, there is a considerable track of high moor; and that part of the west division of the county which lies to the east of the river Leven, is intersected by a continuation of the lovely ridge, which crosses the island from Forfarshire to the Frith of Clyde.

Oats have been long the grain chiefly cultivated in this county. Barley was some years ago raised to a considerable extent, but the high duty on malt, and the demand for wheat, have induced the farmers to give it up in a great measure, and during that period a great quantity of wheat has been raised. Beans are sown in greater quantities than peas, and their culture is daily becoming more general. Spring tares are the only kind to be seen, and these only on the farms of a few gentlemen. Potatoes are cultivated in the most complete manner, and with great success, and are planted on every variety of soil. Swedish, common white, and yellow turnip, and carrots, are cultivated. Rye grass is universally sown for hay. White clover grows naturally on all the dry land, and red clover is sown down with rye grass, but seldom by itself. Flax is less cultivated than formerly, but a little is raised on almost every farm.

There is little rich land kept exclusively for pasture. On most farms the improved husbandry prevails; and each field in rotation, after having been pastured two or three years, is broken up and returned for tillage.

Cows and oxen are chiefly brought from the west Highland, and milch cows from Ayr and Renfrew; only a small proportion are reared in Dumbartonshire. The number of horses in the county, however, is by no means considerable. The only sheep in Dumbartonshire are of the black-faced or mountain breed, with the exception of a few English of the Leicestershire breed, kept by some gentlemen around their houses.

An abundant and truly valuable source of melioration to this county is found in the sea-weed, which is cast in by the sea, and collected on its shores; but it is reckoned much more valuable, when it can be cut with sickles, at low water, in the spring, when it is in a high state of vegetation, and full of sea salts. It can only be cut once in two years, and so soon as it is cut, it is spread very thin on the ground, and ploughed down immediately before its fertilizing juices are exhausted. Lime is much used, and sometimes shell sand. The soil and grounds are, in many places, well adapted for irrigation.

The wages of a farm-servant in 1811, was estimated at L. 18, L. 22, L. 28, and sometimes L. 30 a year, and a woman for farm-work will get from L. 8. to L. 12. a year, and a day-labourer has 2s. and 2s. 6d. per day.

The average price of beef may be estimated at 61. per pound, mutton 9d. veal, pork, grain, and vegetables, are in proportion still dearer. Salmon 1s. 6d. per pound, and salt herrings sell high, as well as every kind of food, owing to its vicinity to large towns.

Copse woods form a very important article in this county. They cover some thousand acres of soil, which would otherwise be altogether or nearly useless, and yield an income to the proprietors almost equal to what they derive from their best lands. Large tracts of land formerly barren are made to yield a large and useful produce. During the last thirty years large plantations have been formed.

Amongst the various extensive manufactures established in this county, the printing of cottons is the most important. It is carried on by seven different companies; and besides the bleaching of printed goods, there are nine bleachfields for whitening cotton goods; three cotton spinning mills; three paper mills; and at Dalmuir iron work, nails, edge tools, and all sorts of wrought iron goods are manufactured on an extensive scale. A large glass manufactury is carried on in Dumbarton. Alkali is manufactured at Burnfoot of Dalmuir. At Millburn there is a distillery of pyroglucious acid. This liquor is employed in making colours for calico printers, and while this liquor is distilling, a quantity of tar and charcoal is produced; and in the town of Dumbarton there are a few taw works.

The only branches of commerce which deserve to be noticed are the importation of grain, and the exportation of the produce of the salmon and herring fisheries. The former of these has long been the staple trade of the port of Dumbarton.

The total gross produce of the salmon fisheries will probably be rather undervalued if stated at L. 1000 a year, and the gross value of the herrings annually caught, (although there are no regular fisheries,)
DUMBLANE, a town of Scotland, in the county of Perth, is pleasantly situated on the banks of the river Allan. It contains many good houses, but is principally celebrated for its cathedral, which was founded by King David I. in 1142. This venerable edifice stands on an eminence on the eastern bank of the river, and overlooks the town. It is 246 feet long, and 76 broad; the height of the walls is 50 feet, and that of the tower, which is a modern building, 125 feet. The cathedral is unroofed; but the choir is kept in repair as the parish church. There are 32 prebends at the west end of the bishop and dean's seats, made of elegantly carved oak, on the north of the entrance to the cathedral.

The following is an abstract of the population return for the parish in 1811.

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhabited houses</td>
<td>473</td>
</tr>
<tr>
<td>Families</td>
<td>693</td>
</tr>
<tr>
<td>Do. employed in agriculture</td>
<td>163</td>
</tr>
<tr>
<td>Do. in trades and manufactures</td>
<td>293</td>
</tr>
<tr>
<td>Total population in 1811</td>
<td>2,733</td>
</tr>
</tbody>
</table>

SITUATION.

DUMFRIES, formerly Drumfries, the chief town of a county of the same name in the south of Scotland, to which it gives its name, is delightfully situated in the vale of Nith, on the left bank of that beautiful river, and somewhat more than a mile below its confluence with the Cluden. There are no historical documents extant by which we can ascertain at what period this town was founded. From some remains of antiquity, however, particularly from two circular mounds retaining the Saxon appellation of moat, one of which was lately to be traced on the high ground at the north end of the burgh, and the other of which is still visible on an eminence to the south-east, we may conjecture that this was a place of considerable resort before the close of the eighth century. If we are to credit etymologists, who derive Drum-fries from two Gaelic words, Drums-fhreas, a hill covered with brushwood, this place must have received its present name before it could boast of a numerous population. It does not appear that there is anything on record relative to its history previously to the middle of the 15th century, when a convent was erected, for friars of the Franciscan order, on a sloping bank, at no great distance from the first of the moats just mentioned. The situation of this religious house must have been very fine. To the north-west, it commanded the rich dale of the Nith, embracing the neighbouring Abbey of Lincluden, 1 and the more distant castle of Dalwinton, then the chief residence of the Comyns. To the eastward stretches the beautiful range of gently rising hills, on which were erected the strong castle of Tortorward, and Amisfield the seat of the once powerful clan of Charteris. To the south-east, romantically seated in the foreground, at a place still named Castle-dykes, was another fortress belonging to the Comyns, 2 with the placid Nith gliding past, and slowly winding through a fine holm 3 towards the Solway Frith; and in that direction the view is bounded by the distant mountains of Cumberland. Nearly due south, the huge Girfeil 4 is the most prominent object, to the right of which is seen a ridge of more rugged and highly picturesque mountains in Galloway; and to the west, upon an extended plain, terminated by the swelling hills of Irongray, stood Terregles, the residence of the Maxwells, chiefs of Nithsdale. The base of the mountain on which the convent stood is washed on the north and west by the Nith, which here makes a beautiful sweep to the southward.

To facilitate the communication of Dumfries with Galloway, the munificent foundress of this edifice caused a bridge 5 to be built across the river, at the spot most convenient for the inmates of her friary. The narrow street which leads from this bridge to the spot where the convent stood, retains the name of the Friars' Vane.

Dumfries having never made a conspicuous figure in history, its annals can only be traced by incidental and insular notices, a few of which it may be proper to specify. It was in the chapel and cloisters of the convent just named, that the two Comyns were slain 6 by the patriotic King Robert Bruce, 7 who was aided on this occasion by Roger 8 de Kirkpatrick, and James Lindsay.

In 1307, the year after Bruce's coronation, when the "proud usurper" again forced Scotland for a time to bear the English yoke, Edward II., advanced to Dumfries, and there received the reluctant homage of several Scottish noblemen. It is even stated by some historians, that he then held a convention of the estates in that town.

From its vicinity to the borders of the rival kingdom, Dumfries was peculiarly liable to the ravages of invaders. It was burnt by the English before 1448, when the Lord Maxwell gained the battle of Sark; and in 1830, it again fell a prey to the flames kindled by these deadly foes. This latter injury did not pass unpunished. It was amply revenged by the Lord Maxwell of the day, who, in the bold spirit of enterprize peculiar to the times, penetrated into England with a small but chosen body of retainers, and having entered Penrith, took the market-cross, by way of bravado, in his arms, and his troops dispersing through the town, reduced it

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1 Lincluden was built about 100 years before.
2 It is not known at what time this building was erected. There is an item in the accounts of the Comptroller of the Wardrobe to King Edward I. which marks the partiality of the English monarch to his protege, 3 and seems at the same time to imply, that the country here described had at that time been deficient in one great ornament, wood. We allude to a charge for a palisade granted by Edward for this castle, from the forest of Inglewood in Cumberland.
3 Then called Comyn's Holm, now Kingholm.
4 In a vale at the foot of this conspicuous mansion, rose the beautiful abbey of Sweet-heart, which was founded by the same pious individual as the convent at Dumfries; viz. Dervegled, or Dervegills, daughter to Allan, Lord of Galloway, and the mother of John Baliol, King of Scotland.
5 This structure is said by some to have consisted originally of thirteen arches, by others of ten; but the number is now reduced to eight, which are still in tolerable preservation, and in consequence of the river having shifted its channel from the right bank, are quite sufficient. This bridge is used only by foot passengers.
6 In consequence of a deed so sacrilegious as the shedding of blood before the very altar, the friary is said to have been interdicted, or at least deserted. Certain it is, that the people began, soon after this period, to resort in greater numbers to St Michael's chapel, at the other end of the town, where St Michael's church now stands.
7 He was son to the cousin-german of the foundress of this edifice.
8 Mr Hume erroneously names this patriot Thomas. The family records bear that he was called Roger.
in a few hours to ashes. About this period, the Maxwells, having increased in power, erected a magnificent castle at Dumfries, out of the ruins, and almost occupying the site of the friary.

We hear little more of Dumfries till the year 1563, at which date Queen Mary and her privy council were there, ratifying a convention of peace with England. Two years after this, her disaffected subjects, having assembles a force in the neighbourhood, under the Earls of Argyile, Murray, and Rothes, Mary advanced upon the town with an army of 18,000 men. At her approach, these obnoxious nobles fled into England; and Maxwell of Terregles, who, on her former visit, had entertained the queen at his house with much hospitality, having now incurred the royal displeasure, was glad to make his peace by surrendering his castle of Dumfries into the hands of his sovereign. The government of this fortress, however, was not withdrawn from the family; for in 1567, we find it vested in the same Maxwell, who, the year before, had by marriage acquired the title of Lord Herries, and was then devoted to the interests of the queen. It was probably in consequence of the decided attachment shewn by so powerful a nobleman to the cause of his mistress, that the populace of Dumfries tore from the market-cross the herald who attempted to proclaim the Lord Murray regent.

In 1570, the castle was taken and sacked by the English under the Earl of Sussex and Lord Sceope, who at the same time did not fail to ravage the town also.

In 1617, after having been many years resident in England, James VI. being seized, as he told his privy council, "with a longing to see the place of his breeding, a salmon in his instinct," set out on a tour through the northern division of his empire, and in his return passed through Dumfries, a place which he had not seen for 29 years before. Here he experienced a reception at once dutiful and affectionate; and it is believed that, on this occasion, as a reward for their loyalty, and an encouragement to martial exercises, he presented to the incorporated trades of the burgh a small silver tube in the form of a gun-barrel, as an honorary prize, to be awarded from time to time to the best marksman amongst their members.

There does not appear to be any thing in the annals of the town worthy of record from this date till 1706, in which year the inhabitants manifested their keen participation in the jealousy excited among their countrymen, by the incorporation of the kingdom with England. On the 20th Nov. a tumultuous meeting assembled at the cross, and there indignantly committed to the flames the articles of Union, with the names of the commissioners. When the rebellion broke out, however, in 1715, the Dumfriessians retrieved their character, and evinced the most ardent zeal in the cause of the reigning family. Hearing that the insurgents intended to march upon the town, they constructed a rampart 1 from the margin of the river, near the most above the town, to St Michael’s church-yard, and from thence to the river again below the town, which was thus completely insulated, being embraced betwixt the extreme points by the natural curve of the Nith. These preparations for resistance proved effectual. The enemy, seeing the determined loyalty of the inhabitants, did not venture forward to the assault, but judged it most prudent to alter the direction of their march. In the rebellion of 1745, however, the town was found in a defenceless state, and was entered without resistance by the insurgent army under Charles, who remained from Saturday evening till Monday morning, and laid the citizens under contribution.

Dumfries has one vote out of five for a member of Parliament. The other burghs grouped with it are Aman, Lochmaben, Sanquhar, and Kirkcudbright. Its municipal government is vested in a town council, aided, in terms of an act of Parliament passed in 1811, by 12 commissioners of police. The council consists of a provost, three bailies, a dean of guild, a treasurers, 12 merchant councillors, and seven deacons of incorporations, in all 25 members. These choose their successors in office, except the deacons, who are annually elected by their respective trades. As nearly as can be ascertained, there are 30 hammermen, 77 squreman, 60 weavers, 40 tailors, 132 shoemakers, 8 skinners, and 17 flesher, in all 464 freemen.

The council chamber being an inelegant and inconvenient apartment, the magistrates, on solemn occasions, assemble in the county court-house, in which they have a share. Here, too, the circuit Court of Justiciary for Dumfries-shire and Kirkcudbright, the sheriff’s court, and the quarter sessions, are held, as well as all county-meetings. The place, however, though new, is ill suited to these purposes, and a large building on the opposite side of the street, originally a place of worship, is about to be prepared for the more convenient accommodation of these courts, after the plan of an eminent architect.

Behind this court house, in a low damp yard, surrounded by a high wall, stands the new county jail. The debtors have the liberty of exercising themselves in this inclosure, the situation of which has certainly not been selected by a medical man. The building is, withal, inconvenient, and much too small for the accommodation of the prisoners; but the removal of the courts, according to the projected improvement, will enable the county to provide more effectually for their health and comfort. Till 1807, the jail was in the centre of the town. The trades’ hall, a chaste and handsome structure, was built in 1804. Besides the apartment peculiarly appropriated to the incorporations, there is one allotted to the meetings of friendly societies for the aid of sick members, or widows and orphans. The trades, as a body, possess a fund of this nature, and each incorporation separately has one of its own; but besides these, there are many private institutions of the same kind in the town.

1 Castle Street in the modern town, passes through what formerly constituted the grounds attached to this edifice, and the place is still correctly named the Castle Gardens.

2 This royal gift the trades preserve with pious care, and on the day appointed for the contest, (a day which recur every five or six years, or oftener if the parties concerned be so inclined,) the silver gun is conveyed in grand procession to a field, where, after having been shot for, it is suspended by a ribbon to the hat of the victor, who enters the town with it triumphantly displayed, and remains its nominal possessor till the next festival of the kind. On these occasions, there is a mazy jousting of the tradesmen, who are all obliged, under a penalty, to answer to their names, and to appear armed with muskets. See Mr Mayne’s poem, entitled the Silurian.

3 A little mount at the east side of the town, near the junction of the roads leading from Annan and Lochmaben, well known by the name of the old chapel, was the site of a chapel raised by Bruce for the repose of the soul of his brother-in-law, whom Edward I. had caused to be hanged on that spot. The rampart passed near this building, the walls of which were pulled down to assist in its construction.

5
Dumfries. 200

In the centre of the square, fronted by this edifice, stands a Doric pillar, intended as an expression of the respect in which the public held the virtues of Charles, emphatically designated the Good Duke of Queensberry. This column was reared about the year 1780, by the gentlemen of the county, who certainly did not anticipate, that in less than thirty years, it would be so far dilapidated by neglect, that not a trace of the inscription should remain.

ChuirJin. It has already been stated, that there are two churches. The original parish church, St Michael's, which stands at the south-east end of the town, was rebuilt in 1745, with a tall and handsome spire. It is surrounded by a crowded burying-ground, which contains several remarkable monuments. Here rest the ashes of Burns, over whose grave a splendid mausoleum is about to be reared as a tribute to his genius. The New Church, for it still preposterously retains that designation, occupies the site of the castle which the Lord Maxwell erected out of the ruins of the friary, and its walls are partly built of the materials which once magnificent fortification afforded. This church is also furnished with a steeple. A third steeple, attached to what was formerly the court-house, obstructs itself rather awkwardly upon the high-street, that it may take its station directly in a line betwixt the two first.

We have already mentioned the bridge built by the Lady Dervigillon over the Nith. That venerable fabric, after having withstood the floods of nearly six centuries, though still fit for service, yet having been built before the common use of wheel carriages, was found from its narrowness to be extremely inconvenient. Accordingly, in 1792, the foundation stone of a new bridge, to consist of five wide arches, was laid a little higher up the river; and, in 1795, this new communication with Galloway was opened. The structure impresses the mind with the idea of strength rather than elegance; nevertheless it is handsome.

The academy is a splendid building, in a fine airy situation, erected several years ago by subscription, but for want of funds, left in an unfinished state. It is supplied with masters of eminence for teaching English, writing, arithmetic, and mathematics. French, Latin, and Greek. There is an evident taste in the place for literary information. There are two public subscription libraries, each of which is well furnished; and in 1812, public reading rooms were opened for about 80 subscribers, where there is also an infant library, and where the most esteemed periodical works are taken in.

Among other useful establishments, is the Dumfries and Galloway Horticultural Society, which was formed in this town in 1812, for the purpose of encouraging industry, improvements, and useful discoveries, connected with gardening, by a judicious distribution of prizes. In the immediate neighbourhood of Dumfries, not less than one hundred acres are occupied by gardens and nurseries.

Nor are the inhabitants less distinguished for their benevolence to the afflicted. They have an infirmary, including a lunatic asylum, and a dispensary; and there is also an hospital for the superannuated, widowed, and orphan poor. Both of these institutions are under excellent management. There is also a female society for educating the children of the poor on the plan of Dr Bell.

The town is well supplied with provisions. The weekly market is held every Wednesday, but there are extraordinary markets for black cattle, of which surprising numbers are sold about Whitsunday and Mair-

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The chief articles of export are grain, potatoes, and wood; the latter, however, not in large quantities. The articles imported are wine, cork, groceries, iron, foreign timber, slates, lime, and coals. The two latter come from the coast of Cumberland.

Under the authority of an Act of Parliament obtained in 1811, the navigation of the Nith has been greatly improved already; and as the plan is far from being completed, is likely soon to be much more so. Formerly, few vessels of more than 40 tons ever reached the town, and these only at high tides. All above that burthen were obliged to unload either at the New Quay, three miles down the river, or at Gleenapple, which is twice that distance. Now, however, in consequence of the removal of obstructions, improving the direction of the channel, and confining the water, vessels of 150 tons can, under favourable circumstances, bring their cargoes almost to the very doors of those to whom they are consigned; and it is expected, by some sanguine ship owners, that ere long, vessels will be seen there of a much bigger burthen still.

From the date of the earliest documents, the population of Dumfries has been uniformly on the increase. Previous to 1695, one church and one minister were sufficient for the parish. In that year, owing to the augmented numbers of the inhabitants, it was found necessary to make the charge collegiate; and, in 1726, the foundation stone was laid of a new church, at the north end of the town, which was then more than three-quarters of a mile in length.

The population of the town,

<table>
<thead>
<tr>
<th>Years</th>
<th>Vessels</th>
<th>Tons</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>1790 to 1794</td>
<td>459</td>
<td>15,718</td>
<td>1310</td>
</tr>
<tr>
<td>1795 to 1799</td>
<td>614</td>
<td>19,833</td>
<td>1671</td>
</tr>
<tr>
<td>1800 to 1804</td>
<td>668</td>
<td>23,640</td>
<td>1810</td>
</tr>
<tr>
<td>1805 to 1809</td>
<td>743</td>
<td>29,427</td>
<td>2069</td>
</tr>
</tbody>
</table>

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The population of the town,

In 1796, was only 5860
1801, there were 5207 males, & 3421 females=8628
1806, 6279
1811, there were 5907 males, & 4023 females=9930
For most of the historical information contained in this article, the writer is indebted to a manuscript of the late Rev. Dr Burnside, minister of St Michael's church in Dumfries, a copy of which valuable document is lodged in the Gentleman's Library there. See also Statistical Account of Scotland; Hist. of Scotland, by Piscottie, Keith, & Robertson; Peter Rae's Hist of the Rebellion; and Stowe's Hist. of England. (G. T. A.)
DUMFRIES-SHIRE, a border county, in the south of Scotland, adjacent to that of Cumberland, in England. It extends in latitude from 55° 2' to 55° 31' North, and in longitude from 2° 39' to 3° 59' West from London. The counties adjacent to that of Dumfries are, on the north, Lanark, Peebles, and Selkirk; on the east, Roxburgh, and part of Cumberland; on the west, Ayr, and the stewartry of Kirkcudbright: the Solway Firth, on the south of Dumfries-shire, separates it from Cumberland in that quarter. According to the observations of Mr White, mathematical teacher in Dumfries, the latitude of this town, which is the most eminent in the south-western districts of Scotland, is 55° 8' 30".

The territory which is now the county of Dumfries, consists of three larger, and many lesser vales, together with the ridges which divide or intersect them; the mountainous tracts at the sources of the main rivers, Nith, Annan, and Esk; and the open country through which they pass, near the Solway Firth. Out of all these tracts, were formed three ancient and separate jurisdictions, the sheriffdom of Nithsdale, the stewartry of Annandale, and the regality of Eskdale; all which are now under the civil jurisdiction of the sheriff-depute of Dumfries-shire, and his substitute. Formerly, the conterminous districts around this county also were known by other names; viz. on the north, Clydesdale and Tweedside; on the east, Ettrick Forest, with Tiviotdale and Liddesdale, and part of the Border Marches; and, on the west, the ancient province of Galloway, and the district of Kyle.

The Solway, on the south, appears to have been connected with the Roman district-name of the Selgovae, of whom the inhabitants of this county, in the time of the Roman empire, were a part, when the province called Valentinia extended from the Solway to the Clyde.

The figure of Dumfries-shire approaches towards that of an ellipsoid; the greater diameter measuring 50, and the lesser 32 miles. The line of circumference consists of 21 miles of sea-coast, 33 miles of low inland territory, and 120 miles in the mountains; being, in all, 174 miles. Of land-surface, the contents are about 1006 square miles; being, in Scots acres, 512,560; and, in English acres, 644,585. The surface of the waters within the county, consisting of lakes, rivers, and streams, is about 10 square miles.

In the lower part of the county, adjacent or near to the Solway Firth, a gently undulating surface, consisting mostly of dry soil, presents itself, intersected by those rivers and streams which flow into the Solway, diversified also by spots or fields of bough or clay soils, and of peat moss. Farther inland, a few lakes appear, mostly in the central district of Lochmaben. Towards the sources of the principal rivers, a range of mountains environ the county on the north, and form its boundaries with those of Ayr, Lanark, and Peebles. These detach considerable arms, terminating in ridges of less elevation, which divide the river-courses, or form the boundaries of the county on the east and west. The general slope and aspect are to the south, in which direction the principal rivers flow. Thus, on the north side the county is mountainous, and partly also on the north-east and the north-west. The middle districts are separated by lower hills and ridges. Three principal dales open towards the south, and lesser lateral vales communicate with each of them, on either side; the courses of the rivers and streams having tracts of holm or bough lands along their margins. As the main rivers approach the Solway, their separating ridges vanish; and their course for some miles is through an open country, elevated a little above the sea, and exhibiting a surface, not level, but in that wavy form which commonly indicates a light soil, improvable rather than rich, and a country naturally adapted for pleasing embellishment and agreeable residence.

From what has been mentioned relative to the mountains on the north, and ridges of hills which descend as arms from these downwards to the maritime parts of the county; and from the aspect of the mountain faces, and the principal dales towards the meridian sun, it may be supposed that the climate of the vales is comparatively favourable. Situated in the southern extremity of Scotland, and so far west as not to be liable to cold rains or hoars from the eastern quarter, the county of Dumfries enjoys a mild climate. It is, indeed, liable to rains from the south-west, especially in the mountainous districts; but, from the south, it is partially protected by the Westmoreland and Cumberland mountains; and, from the west, by those of Galloway and Ayrshire. On the whole, the climate is both agreeable and salubrious. Few clay boggs of remarkable extent exist in it; and, though considerable tracts of peat bog appear in various parts, and one of uncommon extent near Dumfries, in the maritime district,—the marsh-fever seldom occurs within the county. It is particularly well adapted for the rearing of cattle and sheep; and all the kinds and varieties of corn which are cultivated as field crops in the south of Scotland or north of England, prosper in Dumfries-shire. The soil, however, is not commonly suitable for the bean, nor the climate for the later varieties of the pea, as ordinary crops in the fields.

The mountains of Dumfries-shire do not form any regular continued chain. Black Larg and Corsonnene, in the north-west quarter, are on the confines of Ayrshire; the Lowthers are an elevated group of mountains, on the borders of Lanarkshire. Queensberry, on the same border, stands almost in the central parts of Dumfries-shire, into which, in that point, Lanarkshire makes a deep inroad. This mountain appears like a central giant, sending out his arms in several directions. The most eminent of the mountains is the Hartfell group, on the confines of the shire of Peebles, being the highest land south of the Firth in this island, excepting only Snowdon in Wales. This group includes Hartfell and White Coom in this county, and Broad Law in that of Peebles. Ettrick-pan, on the confines of Selkirkshire, and Lochfell near it, within the county of Dumfries, in the north-eastern quarter, and the hills that separate Eskdale from Roxburghshire, all terminate the list of the principal environing mountains which defend this county from the northern blasts; and, forming an elevated barrier in that direction, give Dumfries-shire a favourable slope and aspect to the south.

Of these mountains, Queensberry has been included in the general survey carried on lately by order of the Board of Ordnance, and its elevation has been ascertained to be 2259 feet above sea-level; the latitude of the summit being 55° 17' 24" north, and the longitude 3° 34' 47" west. The height of Wisp Hill in Wigtown has also been found, and is 1954 feet. The spirit-level applied on the top of Queensberry (allowance being made for curvature and refraction), discovers Lochfell to be fully higher, and the Lowthers and Hartfell consider-
Dumfries-shire.

View from their summits.

Rivers.

The chief rivers of Dumfries-shire have already been mentioned, viz. the Nith on the west, the Annan in the central parts, and the Esk on the east. The course of these rivers is towards the south, and they all pour their waters into the Solway Frith. Among the mountains at or near their sources, the Nith is above 20 miles from the Annan, and the Annan above 10 miles from the Nith. As they descend, they approach nearer each other. The Nith, which rises in the county of Ayr, and runs the longest course, contains also most water, and receives the streams of a more extended tract of country. The Annan passes through a wider vale. The river Esk is confined in its course, and enters Cumberland before it passes into the Frith.

Into each of these rivers, various lateral streams descend, on either hand, opening lesser vales into the principal river courses. The Nith receives the waters of the beautiful river Cluden or Cairn, and those of the Shinnel, Scar, Cample, Carron, Minnuck, Eschen, and Kello. The Annan receives the waters of the Milk, Dryfe, Kinnel, Ae, Wamphray, Moffat, and Evan. Into the Esk descend the streams of Eves, and of Liddel, Tarras, Wauchopie, and Meggot.

The Vale of Nith enjoys the benefit of the county town of Dumfries near its lower, and of the royal burgh of Sanquhar near its upper extremity. It possesses also coal-mines near the head of the vale, and well worked limestone quarries near the centre of it. This valley is naturally divided into three parts, by the approach of the hills near to each other on its banks, in two particular places, forming three sub-divisions of the vale; the uppermost at Sanquhar, the middle division at Closeburn, and the lower at the county town of Dumfries: but every stream that has been mentioned as flowing into the Nith, opens a lesser vale to the right or the left. The vale of Annan contains more champaign or open lands, and is less boldly divided by the hills, than that of Nith; yet the ridges approach each other on either side, particularly in two parts; and various lateral vales open into it on each bank. It possesses lime-quarries in the lower districts, but no lime or coal above. The river Esk passes through a vale, for the most part confined, but opening wider near the borders of Cumberland. Coal and lime are found in the lower parts of Eskdale. Besides the main rivers, the Sark, which is a Border stream,—the Kirkle, which, though it flows in the vale of Annan, is not connected with this river,—and the Lochar, which is a dark rivulet, flowing from the moss of the same name,—all pass directly into the Solway Frith.

Those extensive tracts of mountain lands, which are chiefly in sheep walk, near the sources of the principal rivers, are broken, and pleasantly diversified by the interjacent larger and lesser vales, where cattle also are reared, and crops raised in considerable variety. The sheep-walks of Eskdale are mostly green hills, well drained, though naturally moist, and supporting strong flocks of the Cheviot breed. The sheep-walks of Annandale and Nithsdale contain more of rock and gravel, and are therefore drier, and bear a larger quantity of heath. Cheviot flocks occupy most of the sheep-walks of Annandale; and the forest or black-faced sheep still possess a large proportion of those of Nithsdale. Nothing, however, seems to be wanting excepting shelter for the ewes and lambs, to prepare for the introduction of Cheviot flocks into almost every sheep farm in the county where they are still wanting. These mountainous tracts, having vales interspersed, extend over 17 parishes and 597 square miles of territory, being nearly 1/5 ths of the whole surface of the county.

The midlands contain hills and low ridges, with a large proportion of low situated lands; and they possess a few flocks of sheep, together with a considerable number of black cattle, and a corresponding extent of arable soils. The whole contain 18 parishes, and 322 square miles of surface, being about 1/50 ths of the county.

Maritime districts.

In the maritime district, which is nearly all a low country, above 20 miles long from east to west along the Solway Frith, and about four miles broad from that Frith northwards, there is little waste land except peat-bogs. The soil is, or may be cultivated to great advantage. Considerable quantities of corn of all kinds are produced; and a suitable number of cattle, with some flocks of sheep, of the improved breeds, answering low districts, are also reared. This maritime district contains 86 square miles, being about 1/90 th of the surface of the county.

A territory more adapted for improvement can scarcely be mentioned. Yet it may be truly said, that, with respect to most part of it, this work is hardly commenced. The means, in some parts, especially in upper Annandale, are at a distance; neither coal nor lime being worked there; and the markets are also remote. In various parts, the conditions on which lands have been held, are not well adapted for their improvement. There is no certain and easy market within the county for well fed cattle and sheep in quantities. The market for wool is heavy and ill regulated. Many of the farmers are deficient in capital and enterprise. The system of overcropping for corn still prevails, and that of cultivating rich grass in the pastures and meadows is far too little encouraged.

The population has augmented so much as to furnish hands for the labour necessary in executing improvements, and also an additional demand for produce. In 1755, the inhabitants of the country were returned to Dr. Webster at 39,788; by the public statutory returns in 1801, the number had risen to 54,597; and by the same returns in 1811, this number was farther augmented to 62,783; not including 120 yeomanry in three troops, 400 men in a battalion of six companies, and
DUMFRIES-SHIRE. 195

Dumfriesshire.

719 in each of the two battalions of ten companies, first of the Nithsdale, and, secondly, of the Annandale and Eskdale local militia, in all 1558 men; which, with 284 men serving for this county in the regular militia, amount in whole to 2212 men, as the domestic or defensive force of the county. This number, added to the last population list, raises the total number to 65,023 souls, not including those who serve in the regular army or the navy.

The mineralogical structure of Dumfries-shire has been repeatedly surveyed. Professor Jameson published a survey in 1805, which has been designed as the first part of a general survey of Scotland, was drawn up a plan suited for that purpose. Previous to that scientific survey, the county gentlemen, in 1800, had engaged Messrs. Busby, coal viewers from Northumberland, to make a practical survey; and some directions having been prepared by the late Dr. Walker and also by Mr. Jameson, the county meeting of Dumfries gave instructions to the Messrs. Busby, and they made their survey and report in 1800, which was published by Dr. Singer in the Appendix of his Agricultural Survey 1812. Major General Drom of Mount Annan having suggested these useful undertakings, as proper to accompany the map of the county prepared by Mr. W. Crawford, he also formed a table with sections of the mineralogical structure of Dumfries-shire, which was added to the other engravings on that map, and contains a very distinct and intelligent abstract. But few counties have been surveyed of late years, with more general attention than Dumfries-shire; a great deal of useful information was communicated by the Busbys, and also in General Drom's table, and in the work published by Professor Jameson, all in succession; and yet, after all, the field of investigation appears to be little more than opened. The discovery of coal and lime in various districts where these mineral treasures are much wanted, remains yet to be made; and no roof slate or metallic repositories have been opened in consequence of the late surveys.

Transition rocks.

According to Professor Jameson, nearly the whole of the upper part of this county is composed of transition rocks. Among these, he particularly observed grey-wacke, greenstone, and flinty-alum, or grey-wacke-slate. These rocks he considers the oldest in the county, and the basis of all the newer formations.

Next in point of age he reckons the independent coal formation, which pervades the low part of the country, disposed in strata from the Nith to the Esk, over the transition rocks; or lying in hollows of these rocks, as at Sanquhar, Closeburn near Dumfries, at Whitehill, Balderscrag, Corncockle Muir, Chapel Hill by Moffat, and Canobic.

The newest of the universal formations he states to be the flintz trap, covering sometimes the transition rocks, and sometimes the independent coal formation; and consisting in the lower parts of the county, of porphyritic greenstone and amygdaloid from the bridge of Langholm to Denbie; while, in the upper parts, (as between Wamphray and Langholm,) it lies on the summit of transition mountains, generally in the shape of mountain caps, blackish pitchstone being subordinate to it.

Of that arrangement of compound minerals which divides them into five classes, (viz. the primitive, the transition, stratified or secondary class, the alluvial, and the volcanic,) the first and last classes of rocks do not seem to have presented themselves in this county. The transition mountains are of great extent; the secondary strata run up the three principal valleys to the very bases of those mountains; and the alluvial class embraces a variety of soils, the most remarkable of which are the haugh or holm lands, near the rivers, and some fields of sleech near the sea. The practical coal viewers have not made any other distinction than into the primitive or primary rocks, and the secondary or stratified.

From the rocky faces and broken scars of the principal mountains, their conformation seems to be similar to them all. Wacken and trap are the rocks which prevail with slate of different character. Near the bases of the largest mountains, beds of ferruginous clay appear, and masses of conglomerate occasionally present themselves, with black shistus resembling coal, though not containing bitumen, but smelling of sulphur, as black ore of copper does. Here also chalybeate waters frequently issue in springs.

The mines of Wanlockhead are computed as yielding Lead mines, about L30,000 worth of lead annually, one-sixth of which belongs to the Duke of Buccleuch, as the superior and proprietor. The produce in 1808 was 15,552 bars, of nine stones avoidoips each; and the price for that year was L.32 per ton. It has been said that the mines of Leadhills in Lanarkshire, and of Wanlockhead in this county, which are near each other in the same range of mountains, were opened in consequence of a discovery by one Martin Templeton in 1517; but others believe them to have been open of a much older date; and some think they may have been known even to the Romans, whose public roads passed near those mountains, and who might the more readily have known the veins, as most of them have appeared on the surface. It is the more probable, since two lead bars are said to exist still, which had been worked by the Romans, and are marked with the date and the name of the emperor, the one at Ripley, and the other in the British museum. A drift was opened in search of copper and lead, in the mountains near Hartfell, many years ago, without success.

It is now of particular importance to open slate quarries in the districts remote from the sea. The very superior slates of Lancashire, betwixt prime cost, and land and water carriage, are very expensive. Glenochar is remote, and the slate is rather soft, and not always to be obtained.

Among the secondary strata which are found in most of the lower parts of this county, coal is worked at Sanquhar and Kirkconnel, in the north-western part of the county, towards the head of Nithsdale; and also in the parish of Canoby, in the south-eastern parts, near the lower part of Eskdale. It is unfortunately not found in the neighbourhood of the greatest population; nor at Closeburn, or Kelhead, near the principal quarries of limestone. The upper districts of Annandale and Eskdale, which are very remote from the sea, feel exceedingly the want of coal and lime; the mere carriage of a single cart load of the former now costing at least fifteen, and of the latter twelve shillings. The last boring in this county was lately made in the vicinity of Moffat, in search of coal. It was put down about 100 feet, mostly at the expense of the ordinary inhabitants, and went through various thick seams of red sandstone. This colour has been commonly held as an unfavourable sign of coal; but it has been understood of late, both from concurring facts, and the admissions of men eminent for mineralogical science, that coal does really associate with red sandstone. The
DUMFRIES-SHIRE.

Red sand-stone alternating with coal.

In the bogs of Canoby, where Mr Keir bored to the depth of 148 feet, thick beds of red sandstone were found alternating with what are commonly denominated the coal metals. At Sanquhar, the Bushy's remarked, that in proceeding towards the dip of the seams, a stratum of red sandstone, six feet thick, appeared to overlap the coal metals; and, at Whitehaven, they observed, that the coal appeared to have a connection with that of Workington; that, for a considerable way towards St Bee's Head, there is a great body of red strata, in some places reported from 45 to 60 fathoms, chiefly of the sandstone and shistose description, with some reddish limestone also, all much resembling those of Annan-dale; that at the sea shore, where the seam of coal is 14 feet thick, the workings are 120 fathoms deep, the red strata overlapping the coal metals; and that the present workings below the sea are opposite to St Bee's Head, where the greatest body of the red strata appear, below which is a seam of coal, about 18 inches thick, succeeded by the ordinary coal metals.

These facts, and many others, naturally lead to the opinion, that coal may be discovered below the red sandstone of Dumfries-shire; but that 140 feet cannot be considered as a sufficient depth for a fair trial. Yet none of the late unsuccessful borings have been carried farther; although at Canoby it was beyond this depth that the best workable seam appeared.

The mere existence of coal, however, is not the only consideration to be attended to. In the neighbourhood of Criffle, a mountain in the strewary, but near Dum-fries, the coal metals, and even thin seams of coal, appear; but they are in a disturbed and confused arrangement, probably owing to their approaching schistose rocks in that mountain. Coal appears in various parts, as in Achintaggert-burn, but of inferior quality. The regularity of the seams, facility of working them, quality of the coal, population of the district, means of working pumps by water wheels, and facility of conveyance to other parts, are all considerations of importance; together with the price and value in the place where a seam is found.

The use of lime in this county is very liberal and extensive, not less than 1,500,000 Winchester bushels of shells being used annually, one way or other. This would fully load 100,000 single horse carts; and four-fifths of the whole are computed to be consumed on the land, about 14,000 acres being manured with lime. The lands within the county furnish the greater part of all this; and the remainder is imported by sea, or enters the upper district of Annandale from the Douglas lime-works in Lanarkshire, and the head of Nithsdale from Ayrshire. About 140,000 acres of cultivated land are under the lime husbandry in this county; and in-calcable improvement has thereby been effected in the soil and produce. The total expense is now rising very high, approaching to L60,000 a year for lime as a manure; and on each acre leading to an expenditure of from L.4 to L.5 every ten years, being annually from eight to nine shillings. The prices are also rising; and if it be desired that farmers should drain and lime their waste lands and common pastures, efforts must be made for coal to burn the lime, and for coal and lime also in the remote districts.

The principal of the present lime-works are those of Closeburn and of Kelhead; but other kilns have been opened in various parts of the lower districts of Annan-dale and Eskdale, or in the central parts of Nithsdale. In this latter part of the county, coal is carried down from Sanquhar by land, a considerable distance, to burn the lime; and most of the other kilns are supplied with coal water-borne from England, and subject also to land carriage from the Solway Firth.

The limestone of this county is generally stratified, and contains very thin seams of clay between the strata, which are useful in separating and working the stone. Petrifactions are frequently found in it of different kinds; and sometimes hollows occur in the stone, either empty, or filled with clay. The Barjarg limestone is a continuation of the same that occurs at Closeburn. The brown muir limestone is supposed to extend through most parts of the lower district of Annandale. The Blackwood ridge limestone is mixed with clay, but yields very white and pure lime, and appears to be the same with what is worked also at the Doukins. At Calronlee and High Muir, the stone is trough-shaped. In Eskdale, the coal formation begins at Langholm-bridge, and extends to the Solway Firth; and limestone appears in many different places of this district.

The valued rent is in Scots money, (ascertained in the protectorate or usurpation, and adopted virtually thereafter,) L.158,627 : 6 : 8; which in merks Scots is 238,000, and in sterling money L13,223 : 18 : 4.

The real rents taken from the statistical volumes, and corresponding nearly to the medium year 1795, were L.109,700; and the returns of land rents and of different mines to the tax-office in 1808, were L.219,037 : 10 : 8. But the present value of the lands and mines of the whole county, in open market, is greatly more.

The great western Roman road from Carlisle into Roman Amnandale and Nithsdale, and up these districts to the Castle of Crawford, where the lines meet, having also a branch up Eskdale to Castle Onil, was planned by Agricola; and being executed by his successors, was most frequented by the Roman armies down to the time of Severus. Many remarkable stations occur in the vicinity of these lines of road; and coins and other things have been discovered, indicating that Romans had frequented the country.

Dumfries-shire is now opened up by six lines of Turnpike turnpike roads; five of which are under the direction of the commissioners within the county, having twenty-nine toll-gates, and returning for the year ending at Whitsunday 1811, the gross rent of L.4134, 5s. One important line is now carrying through, executed partly by the commercial interest of Glasgow, and partly depending on subscriptions in this county and on government aid. The district or county roads and bridges, are made and repaired by the converted value of the statute labour, now authorised to be raised as high as 30s. in the 100 merks valued rent from the occupants of land, which, if carried to the maximum, would raise a gross fund of L.3570 a year: in aid of which fund, the county is in use to assess landholders to a moderate sum for bridges; and individuals are also accustomed to subscribe.

Manufactures on a very moderate scale are carried on in carpets, in paper, cotton-yarn, spades, tanned leather, soap, candles, salt, ale, and beer, porter and stockings. Linen is hardly made for sale, though it is manufactured for use. The manufacture of wool is almost lost in this county, and over Scotland in general, for want of correct stapling houses, to assort the raw material.

Commerce is improving; and by the Custom-house Commerce, returns for 1809, there were 493 cargoes inwards, and
DUMFRIES-shire.

287 cargoes outwards; the total of the burdens 29,427 tons.

The royal borough of Dumfries is the county town. The other royal burghs are Annan, Lochmaben, and Sanquhar. Annan is already much improved; but it wants a port. Lochmaben stands in the finest and most open and improvable district in the county, and is likely to be soon improved materially, together with the adjacent country, by means of a canal from the mouth of the river Annan by the line works at Kelhead.

The fine village of Moffat, situated at the base of Hartfell mountain, sheltered from the north and east, and furnished with sulphur and chalybeate waters, and with accommodations for genteel strangers,—is well known. That of Langholm on the river Esk, and of Thornhill on the Nith, are advantageously situated. New villages have been laid out on the properties of Dalswinton, Mount Annan, Kellhead, and Rockhall.

It is not supposed that the woods and plantations of the whole county exceed six or seven thousand acres. Many of the heath ridges appear to have been in culture for corn at a remote period of time; and peat mosses have accumulated in rich forest lands. The Scots pine grows in some of these lands, and it is not considered as interfering with the mountain arms of Dumfries-shire, that intersect it from north to south, are admirable subjects for the planter to work in.

The total number of sheep is supposed to exceed 200,000. Of these mountain flocks, the greater part are now of the Cheviot breed, and next in number are those of the black-faced breed. Lesser flocks of New Leicester sheep are reared in the lower farms, by the most respectable improvers. A few small parcellers, also, of the Spanish, and some of the Merino blood. The cattle are mostly of the Galloway race, and rise in number to about 30,000. It has been found, that so many pigs are now reared as to furnish bacon for export from the county, to the extent of nearly L.50,000 a-year. The returns made in gross from the milk cows and other cattle, and from the sheep in the common walks and lower districts of Dumfries-shire, have been computed as rising above L.300,000 a-year. The gross produce of the crops raised on 150,000 acres of cultivated soils, is considered as rather more than all the returns from live stock; the lands in pasture not being included.

The number of the freeholders on the last roll was 74; and that of the commissioners of supply about 198. There are 20 deputy lieutenants to assist the lord or vice-lieutenant in arranging and maintaining the domestic force of the county; and the justices of the peace exceed 140.

The property taxes levied in this county for the year 1808, after all deductions and abatements were made, amounted to £31,709. 1s. 7d.; being from two to three times the whole valued rents at the time of the usurpation.

Wheat is now cultivated throughout all the county, except in the very highest parts of it. It is believed that in remote times, this valuable grain was cultivated in quantities in Dumfries, Galloway, and Ayr. Oats are in high perfection, raised in all parts of the county. Potatoes are almost the staple produce. Sown grasses and meadow hay are abundant.

The principal articles of export are, in lead, cattle, wool, grain, and potatoes; and those of import consist mostly of coal, slates, and foreign pine timber, with groceries of all kinds, wine, and iron.

The most venerable castles are those of Caerlavock, Lochmaben, Achnasc, Morton, Sanquhar, Comlongan, Torforth, &c.; and the chief houses are those of Drumlanrig, Ruchill, Dalswinton, Castlemilk, Closeburn, Springkell, Blackwood, &c.

The fisheries in the rivers are greatly failed of late years. This failure is ascribed to the killing of the spawning fish in these rivers; and a new act to prevent it was lately obtained. But it proceeds very much from the almost entire capture of the fish as they move up the Solway, in the numerous nets that are placed there in the salt water.

Fuel, in various parts of Dumfries-shire, is expensive; coal being remote, and the peat-mosses requiring much labour, time, and expense.

The common lands, in this county, have been either altogether or for the most part divided, and are now either improved, or in process for that purpose. A great proportion of the marches of conterminous estates have also been straightened and fenced; and enclosure and subdivision are going forward in most of the farms.

(See Botany, p. 78.)

DUMOS.E. See Botany, p. 78.

DUNBAR is situated at the mouth of the Frith of Forth. It consists of a large and spacious street, extending from north and south, and containing many good houses, which are in general three stories high. The principal public buildings are the Town Hall, the Church, and the New Inn. The Town Hall is a wretched building, with a paltry spire in a state of extreme decay. The church is a long mean building, with a square tower at its west end, having small turrets at each angle, and a larger turret in the centre, by way of a spire. The New Inn is one of the best buildings of this kind in any of the provincial towns of Scotland. It is three stories high, large and commodious, with suitable stables, &c.

At the north end of the principal street stands the residence of the Earl of Lauderdale, with its back turned most contumaciously to the town, and forming the actual termination of the street. The front of this house is built of fine freestone. It has a semicircular porch supported by six columns of the Ionic order. The wings, which are unusually large, are higher than the body of the house, and appear to contain the public rooms. The whole establishment runs along the front wall.

The harbour of Dunbar is far from being large. It consists of an inner and an outer harbour with a dry dock. In the inner harbour there is generally 16 feet of water at stream tides. The outer harbour is defended by a small fort, mounted with several cannon, and standing upon a rock of columnar sandstone.

The ruins of the old castle of Dunbar stand to the north east of the harbour. It is situated on several projecting rocky promontories, hollowed out by the action of the sea into huge caverns, sometimes open above, and crossed by natural arches of rock. It has a very interesting and unusual appearance, and is particularly deserving of notice. (ed.)

DUNDEE, a sea-port and manufacturing town in Scotland, is situated on the north bank of the Frith of Tay, and within the county of Angus or Forfarshire. In 1811 the population amounted to 29,716, exclusive of seamen and militia, being an increase in ten years of nearly 4000; and the seamen belonging to this port amounted at present to about 1273. The town of Dundee is far from elegant; but there are many handsome public buildings and private houses in it. The High Street is an oblong 360 feet in length, by 100 feet broad; the other streets diverging from it are generally narrow. A little to the west of this street stands the
Old Church, having a large square Gothic tower 156 feet high; on the south side of it the town-house is built upon the site of an old church, and contains a guild-hall, court-room, prison, the Dundee bank, &c. At the east end of the square there is a handsome trades hall. St Andrew's Church is an elegant new building, with a spire 139 feet high. A large infirmary has been for a considerable time established; and a lunatic asylum, planned by the late Mr Stark, is partly finished. The other public buildings of any appearance are a small theatre, and a new Gothic chapel for an Episcopal congregation.

Dundee is a royal borough. It has enjoyed privileges as ample as those of any borough in Scotland, since the reign of William, which began in 1165; and these were recognized by a charter of King Robert Bruce, dated March 14th, in the 22d year of his reign. The privileges were greatly increased in subsequent reigns, until, in that of James VI. in January 1601, they were all confirmed, and last of all ratified by Charles I. in what is called the great charter, which bears that all its articles were ratified in parliament, 1641. The government of the town is vested in a council of twenty persons, who, in the ordinary way throughout Scotland, choose a provost and four bailies annually. The revenues, of which the magistrates have the management, amount to about 4000 per annum.

The trade of this port is very considerable, and although of late years the actual exports and imports, owing to the general obstructions of commerce, afford no adequate idea of the tendency to increase, we shall state them for the year 1813, with this remark, that the direct imports and exports bear no proportion to the goods carried to and from Dundee coastwise, which are not here included.

**Imports in 1813.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Tons.</th>
<th>Cwts.</th>
<th>Qrs.</th>
<th>Lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flax</td>
<td>1201</td>
<td>15</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Hemp</td>
<td>1097</td>
<td>10</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Iron</td>
<td>425</td>
<td>10</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Tallow</td>
<td>113</td>
<td>15</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>Ashes</td>
<td>20</td>
<td>15</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Linseed</td>
<td>4621</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Exports in 1813.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Tons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sailcloth</td>
<td>2895</td>
</tr>
<tr>
<td>Linens</td>
<td>14,772</td>
</tr>
<tr>
<td>Refined Sugar</td>
<td>410 cwt. 1 qr. 7 lbs.</td>
</tr>
</tbody>
</table>

In 1791 the exports to foreign ports, entered at the custom-house, were 72,777 tons. The imports same year, 2839 1/2 tons of sundry goods; 1086 hogs. of linseed; 1700 loads of fir timber; 6300 fir bales; and 13,100 fir deals. In the same year the goods sent coastwise were 7,842,000 yards of linen, 150,752 pounds of thread, 280,000 yards of sailcloth, 65,000 yards of cotton bagging, barley 23,917, and wheat 5007 quarters. The goods brought coastwise, in that period, were cotton wool 35 tons, tea 47,745 pounds, 1080 hogs. of porter, 23,021 tons of coals, sugar 5834 tons. There are at present 30 vessels of different sizes belonging to Dundee, employed in the foreign trade, 4901 tons; 116 ships, 7384 tons in the coasting trade; and 8 ships in the fishing trade, 2624 tons; making the whole tonnage of shipping belonging to the port 14,890.

The same causes which of late have had a prejudicial influence on trade, have also operated on manufactures, and those of Dundee can only be correctly viewed by taking a retrospect. The linen manufacture has been long carried on in it to a great extent. Between 1788 and 1789, the quantity of Osnaburghs stamped amounted to 4,249,653 yards, valued at L108,782, 14s. 2d.; and supposing a fourth of this quantity to have been brought from the neighbourhood to the Dundee stamp-offices, the quantity made in the town and vicinity would be 3,181,990 yards, worth L80,557, 0s. 8d.

We add a note of the stamped linen cloths for the last four years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Value L.117,166</th>
<th>6 11</th>
<th>L4,899,518</th>
<th>6 11</th>
<th>L2,822</th>
<th>2 11</th>
<th>L2,706,305</th>
<th>6 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1810</td>
<td>2,963,658</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>11</td>
<td>91,042</td>
<td>2 11</td>
<td>5</td>
</tr>
<tr>
<td>1811</td>
<td>2,822,814</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>11</td>
<td>91,042</td>
<td>2 11</td>
<td>5</td>
</tr>
<tr>
<td>1812</td>
<td>2,809,461</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>11</td>
<td>100,154</td>
<td>7 5</td>
<td>5</td>
</tr>
<tr>
<td>1813</td>
<td>2,144,134</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>11</td>
<td>96,705</td>
<td>2 4</td>
<td>2</td>
</tr>
</tbody>
</table>

Besides Osnaburghs, there is a great deal of canvass for shipping manufactured, probably nearly 800,000 yards annually. This, however, is mostly a war manufacture. Besides bagging, diapers, and various coarse linen cloths, the cotton manufactures have been carried on to a considerable extent. A woollen cloth manufacture has recently been established. White and coloured linen threads, and every other species of manufacture now generally introduced into Scotland, have obtained a footing in Dundee, and are carried on with as much spirit and success as in other parts of the country.

As connected with the trade and manufactures of this town, we may notice the banks, viz. the Dundee, New, and Union Banks, which are local, and a branch of the British Linen Company.

This town has made a figure in the history of the country. It was twice taken by the English in the reign of Edward, and retaken by Wallace and Bruce, by the latter of whom the castle was demolished. It was taken and burnt by Richard II. and again in the reign of Edward VI. of England. The Marquis of Montrose took it by assault, and it was saved from pilage by the covenanters. It was lastly taken and entirely pillaged by Monk, in Cromwell's protectorate—

one sixth of the inhabitants having been destroyed on that occasion, and all the soldiers loaded with immense booty. Wallace, the Scottish patriot, is said to have been educated at the school of Dundee, and to have commenced his achievements by killing the son of the English governor.

Dundee is a Presbytery seat. There are eight clergymen of the established church, (two of the charges are collegiate,) who officiate in four churches and three chapels of ease. In one of the latter, the clergyman preaches in Gaelic, although very few understand that language. The stipends of the clergy are very inadequate. The dissenters are divided into the following classes: two congregations of Burghers, two of Antiburghers, two of Relief, two of Glassites, and two of Episcopalians. Baptists, Methodists, Bereans, Independents, Unitarians, and Roman Catholics, have also meetings. The Halkinute Independents had a large house, capable of containing 2600 people; but it has been lying waste for several years. The means of education are, 1st, An academy, which is so far a charitable institution, that at least L300 per annum is mortified for the education of boys and girls, the former of
The Abbey, of which nothing but the ruins now remain, is another interesting relic of other times. It was one of the earliest and richest religious houses in Scotland. It was founded as a monastery by Malcolm Canmore, for the monks of the Benedictine order, completed by his son Alexander I. and dedicated, with its church, to the Holy Trinity, and St Margaret, the queen of Malcolm. It was governed by a prior till the reign of David, who converted it into an abbey; and was at one time so magnificent and extensive, that "three sovereign princes, with all their retinue, might have been lodged conveniently within its precincts." Its revenues were derived from places at a considerable distance; but it suffered with the ravages of the reformation, with the other monuments of superstition and royal prodigality. The Abbey was nearly burnt down in the 14th century. Edward I. wintered at Dunfermline in 1303. The church and some cells which had been spared, were, however, nearly demolished in 1500, by the reformers; and the Abbey being erected into a temporal lordship in 1593, and bestowed on Queen Anne of Denmark, all that now remains of this once splendid ecclesiastical edifice, is a part of the great church, built by Malcolm, and the rubbish and ruins which surround it. The part of the church which is still preserved, is occupied as a place of worship. Adjacent to the church, the cemetery of many kings of Scotland is pointed out; and we learn from Sir Robert Sibbald's History of Fife, that the following royal personages are here interred: Malcolm III., Queen Margaret, King Edgar, Alexander I. Sibilla his queen, Henry III., Edward, David I. his queen Margaret, Robert I. his queen Isobel, Edward II. son of Malcolm III.; his brother Etheldrade, earl of Fife; M'Duff, earl of Fife; Constantine, earl of Fife; William Ramsay, earl of Fife; Thomas Ilandel, earl of Murray, governor of Scotland. Robert the Bruce, the most illustrious of our Scottish kings, is also said to be buried at Dunfermline. But all marks of royalty are obliterated from their graves.

The manufactures of Dunfermline are principally diaper and damask, for which this town has long been distinguished. A few years ago, the annual receipt from the sale of these kinds of cloth was calculated to amount to L.150,000; but of late, a great diminution has taken place. The manufacturers in Dunfermline, and its immediate vicinity, who, in September 1813, amounted to 1114, were, until within the period alluded to, employed exclusively in the manufacture of diaper and damask, but many of the operative weavers now receive work from Glasgow, and other places, and some are still altogether unemployed. Great improvements have been made in the Dunfermline branch of manufactures, and there are at present many persons employed in it. For a long period, the goods manufactured were chiefly bought for the London market, by people who came and purchased them on the spot; but for the last twenty years, great quantities of them have been disposed of in the usual way, by the manufacturers going to London, and other places, and receiving orders. Previously to 1749, it was customary to weave ticks and checks during the winter months; but since that time, until of late that the cotton goods for manufacturers in Glasgow, &c., have been woven, nothing, comparatively, but damasks and diapar and damask have been made in Dunfermline.

Dunfermline is the seat of a presbytery; and recently a sheriff-substitute has been appointed, and holds courts for the administration of justice in the western district.
DUNFERMLINE

DUNFERMLINE

DUNKIRK

DUR

DURAND

of Fife. The magistrates also exercise a jurisdiction
consistent within burgh. Besides a parish church, which
is a collegiate charge, there are various places of public
worship, and a great variety of sects: Ralph Erskine, a
leader in the secession from the established church of
Scotland, in 1740, was one of the ministers of Dunfer-
mline. There are a chapel of ease, a relief meeting-house,
two Burgher and two Antiburgher houses, two congrega-
tions of Baptists, and one of Methodists. There is
no parochial school; but a grammar school, the patron-
age of which is in the Marquis of Tweeddale, on the
recommendation of the town council, has long existed in
the burgh. Besides the doctor of the grammar school,
there is a "master of the song," or precentor, who
may teach church music, the English language, and arith-
metic, also under the same patronage. But these means
of education have been found too extremely deficient, that
there are several private schools in the town; and the
council, guildly, and most respectable inhabitants, have
lately united in subscribing liberally for the purpose
of erecting and endowing an academy suitable to the place.
A master has been chosen, but the arrangements are
not yet completed for settling the Establishment. The
Lancastrian system of education, in a modified shape,
has been introduced with success; and there is one
gratis school for the instruction of poor children. There
are three subscription and one circulating libraries in
Dunfermline; two subscription coffee-rooms, and various
institutions of a charitable character, the particular
objects of which are partly of a permanent and partly
of a casual description. The poor, of whom few beg,
are supported by the contributions of the hiritors, and
the collections at the church doors; but a great deal is
done to prevent the increase of parochial paupers, by
means of friendly and other benevolent societies. In
1812, the money given by these, chiefly to poor house-
holders and distressed families, amounted to about
L.1500. A guildhall has lately been erected, but is not
yet finished. It is a handsome building, with a spire,
and will contain rooms for public purposes, an inn, &c.
There are eight fairs in the year, and two weekly mar-
ets, one for the sale of grain, and another for butter,
eggs, &c. There are branches of the bank of Scotland,
and the British Linen Company; and four agencies for
insurance companies against fire. Formerly there was
a considerable number of breweries, and a distillery;
but there are now only five common brewers, three of
whom make strong ale and porter. The town is amply
supplied with water, brought in pipes about two miles.
The streets are well lighted and paved; and many of the
houses comfortable and well built. Coal is abundant,
good and cheap. There is one good inn, and above
100 of an inferior description. The situation and
vicinity of Dunfermline are extremely pleasant. See
Statistical Account of Scotland, &c. (A. P.)

DUN. See Agriculture Index.

DUNFERMLINE, or DUNKERQUE, in Dutch and Flemish
Brabant, a considerable sea port of France, in the
department of the North, 50 miles north-east of Calais.
The name denotes the "church on the Downs, or sand
hills," and the place is of great antiquity. It belonged
for several centuries to the Earls of Flanders, and
passed, in the 15th century, to the House of Austria.
It remained under the Spanish branch of that House a
considerable time, but changed masters more than once,
in the war in the Low Countries carried on in the mi-
nority of Louis XIV. Cromwell having taken part
against Spain, and having assisted the French in ob-
taining possession of Dunkirk, it was put into his
hands, and its fortifications considerably extended by
him. It remained, however, only four years in our
possession, Charles II. selling it, in 1662, to Louis XIV.
for the sum of L.209,000 sterling. That ambitious
monarch expended large sums in strengthening its for-
tifications, so that Dunkirk afterwards became the seat
of very formidable annoyance to the English commerce.
It is said, that in the war of the Succession, the prizes
brought into Dunkirk exceeded the value of a million
sterling; a loss of such importance, that, at the peace
of Utrecht, our ministers made a point of stipulating
for the destruction of the fortifications, and even of the
harbour. This accordingly took place, in a considera-
ble degree, in the year 1713; but though, in the sub-
sequent treaties of 1748 and 1763, similar stipulations
were inserted, the French contrived to evade their ex-
ecution, and the British ministers have been disposed
to consider the insertion of the article as little else than
an expedient for acquiring popularity. Since the
American war, the French have been at liberty to
improve the harbour and fortifications as they thought
proper. It is generally thought, that the Duke of
York might have succeeded in taking possession of this
place in the autumn of 1793, had his operations been
properly combined. Rechard taking his account from
the Terrier office, (le Bureau de Cadastre,) makes the
population of Dunkirk to be 16,832. It may be taken
at about 22,000. The houses are built of white brick.
The communication between the harbour and the in-
terior of the town is by a quay, which is very long and
solid. The rope yard and sailors' magazine are two
buildings, each of nearly 600 feet in front. The bar-
racks are beautiful. There is here a public school for
teaching mathematics and hydrography. The roadstead
of Dunkirk is at the distance of a mile and a half north
of the town, and lies within a sand bank, which runs
parallel to the shore for an extent of nearly five miles
in length. Of late years, it has suffered in point of
trade in the same way as other towns in France, and
its inhabitants have little other occupation than that of
privateer trade, and of a few inland manufactures, such
as glass, ropes, leather, delf ware and starch, &c. In
the time of peace, it will, in all probability, enjoy a considera-
ble foreign trade, and might be expected to employ nearly
200 merchantmen, and 2500 or 3000 seamen. It is
the native place of the celebrated Jean Bart. E. Long.
2° 7', N. Lat. 51° 2'.

DUODECIMAL of a Tone, in Music, (,) is an
interval which Aristoxenus, according to Dr Holder,
constituted as a degree, or common-measure for inter-
vals. It is \(\pm 8.60545 \times m\), or \(8.60545 \times m\); its
common logarithm is .957372,8980 = .0141063 in
Euler's log's, or decimals of the octave: = .790117 x
= 8.607307 \times \Sigma, &c. Some of the ancient writers
on music seem to have assumed, that this interval was
the same with \(\pm 1\) of the minor fourth, but which is
\(8.489514 \times m\), \(9.95833,7545\) in common log's;
and others, that it was the same with \(\pm d\) of the octave,
but which is \(8.522869 \times m\), \(9.958190,2784\). These
differences, though so small apparently in these small
intervals, are nevertheless sufficiently great, when often
repeated, in composing or calculating of intervals by their
means, as to render them very unfit for their intended
purpose. See Common-Measure of Intervals. (c)

DURA MATER. See Anatomy.

DURANTA, a genus of plants of the class Didynamia,
and order Angiopermia. See Botany, p. 255.
DURER, ALBERT, a celebrated German painter and engraver, was born at Nuremberg, A.D. 1471. In the shop of his father, who was a goldsmith, he made his first essays with the pencil; but was taught by an inferior artist named Martin Hupe, to manage colours, and engrave upon copper. When he was about 20 years of age, he began to exhibit some of his works to the public; and soon acquired great celebrity by his engravings. He was one of the first improvers of that art, which he carried to a high degree of perfection; and, excepting his contemporary Michael Angelo Buonaroti, he had no equal during his life. He possessed an inexhaustible fund of designs; and, in order to execute them more expeditiously, he engraved many upon wood. His prints are, of consequence, extremely numerous, and were rapidly bought up as soon as they were thrown off. Besides the excellence of the execution and design, they possess a recommendation, which was not common among the productions of those times, namely, that they are entirely free from obscene representations. One of his best engravings is that of St Eustachius kneeling before a stag, which has a crucifix between its horns; and the principal merit of this piece is supposed to consist in the beauty and variety of attitude imparted to the dogs. He did not produce many paintings; and few of them are now to be seen, except in the more rare collections, or in the palaces of princes. One of the most eminent of these is his painting of Adam and Eve in the palace of Prague, which Gaspar Velius has celebrated in the following couplet:

Angelas voserns, miratus icti, ab horro,
Non ipsa forma; vis ego depurata.

He was well skilled also in statuary, architecture, optics, and geometry; and wrote several treatises upon these subjects, which were published after his death, after having been translated from the original German into the Latin language. He enjoyed the patronage and esteem of the Emperor Maximilian, who bestowed upon him a handsome pension, with letters of nobility; and he continued to experience the liberality of Charles V. and of his brother Ferdinand, king of Hungary. He was for many years the chief magistrate of his native city; and, being in easy circumstances, practised his art more as an amusement than a profession. He lived, however, in a very frugal style, and with all the appearance of poverty rather than of wealth; but was a man of cheerful dispositions, and highly agreeable in conversation. Distinguished, in short, by the mild virtue of his character, as well as by the extent of his genius, he was highly respected during his life; and died at Nuremberg in 1528, where his friend and patron Pircheimer, has honoured his memory with a suitable sepulchral inscription. See Melchior Adams in vitis Philos. German; Vasari de Pittori; Sandrart, Pinxit, &c. (q.)

DURHAM is a county town in the north of England. Its form is nearly that of an equilateral triangle; the eastern side, from its southern extremity at Stockton to the mouth of the Tyne, measuring rather less than the distance of two points from its western extremity, where it joins the counties of Cumberland and Westmoreland. It is situated between the latitudes of 54° 29' and 55° 3'; on the north it is separated from Northumberland by the rivers Tyne and Derwent; on the west from Cumberland and Westmoreland, by the Crookburn and the Tees, and by barren hills and moors; on the south and south-east, from Yorkshire by the Tees; and on the east it is bounded by the German Ocean. The greatest extent of the county, from Shields in the north to Stockton in the south, is rather more than 36 miles; and its greatest breadth, from the peninsula of Hartlepool on the east to the mouth of the Crookburn on the west, where the three counties of Durham, Cumberland, and Westmoreland unite, scarcely reaches 45 miles. Its circumference is about 186 miles, and it contains about 582,400 acres. It is divided into four wards: Chester ward, which contains three divisions; Darlington ward, which contains the same number of divisions; and Easington and Stockton wards, each of which contain two divisions. But besides these, part of the county of Durham lies at the north-eastern extremity of England, separated from the main body of it by the whole length of Northumberland. This detached portion is divided into two parts, Islandshire (so called from its comprehending Holy Island,) which commences a little to the north of Bamborough, and runs along the sea coast, and for seven or eight miles inland, as far as Berwick upon Tweed; and Norhamshire, which lies to the west of Islandshire, and runs up Tweedside, nearly as far as where the Till falls into that river. These two detached portions of Durham contain about 72 square miles of good land, well cultivated. This county pays three parts of the land tax, and provides 400 men for the militia. The natural districts of Durham are not very distinctly marked; nevertheless the sea coast may be distinguished by a flatness and tameness of surface, when compared with the centre parts of the county; the banks of the Twees by lowness of situation, and productivity of soil; the moorlands, which occupy the western parts of the county, on the contrary, are characterized by elevation and barrenness; and the interior is marked by the irregularity of its surface, and the diversity of its soils, comparatively with the rest of the county. The principal vale land consists of the Vale of Stockton, which is well defended by the round, prominent hills, which rise about nine miles northward of the Tees; the flat vale land spreading seven or eight miles from that river. The central district is the largest of the natural districts, commencing at the foot of Gateshead-fell, and extending southward as far as the vale of Stockton: the sea coast district bounds it on the east; and the moorlands, with the valley of Walsingham, on the west. The general appearance of the moorlands of Durham is similar to that of the moorlands of Yorkshire and Northumberland. It is crossed by that ridge of hills, which have been not unaptly called the Pennines of England, though none rise very high in this county. From this description of the face of this district, it will be seen that the general aspect of the county is hilly and naked. As it extends from the sea coast nearly to the top of Crossfell, which is 3400 feet above the level of the sea, the climate of Durham must vary very considerably. In favourable seasons, and early situations, the harvest commences about the middle of August; but when the seasons are cold and wet, little corn is cut, even in the low and sheltered parts of the county, before September; and not unfrequently, in the western parts, it is protracted till the beginning or middle of November. In the spring, cold north and easterly winds prevail; these sometimes continue till the beginning of June, and are succeeded by south and westerly winds, bringing much rain; but the heaviest falls of rain and snow are from the south-east.

Climate.
The soil, in the south-east part of the county, is for the most part a strong fertile clayey loam; to the westward of this, and northward, near Sunderland, is a poor unfertile clay, suitable neither for corn nor grass. The vale lands of the Tees, Skern, and Tyne, consist of dry mellow loams, rather strong; the vale lands of the Wear are of a more friable and sandy nature. There are two districts of limestone; the eastern, beginning at Sunderland, and stretching to Mornington, is dry, but not very productive; whereas the soil on the western limestone, near Stanhope, &c. ranks among the best grazing lands in the north of England. A variety of soil, very thin, and lying on an impervious yellow clay, is found in many parts of the county, to which, from its being apt to throw out the plants of wheat, &c. when the water which lies on its surface is frozen, the appropriate name of water shaken is provincially given. Peaty soils, incumbent either on yellow clay, or white sand, prevail in most parts of the western division of the county. The principal rivers which flow into the sea, are the Wear and the Tyne; the Tyne is more generally considered as a Northumberland river. The Wear rises in those vast moors which separate Yorkshire from Durham, Cumberland, Westmoreland, and Northumberland. It runs at first to the south-east; at Bishop Auckland it turns to the north-east, and after nearly surrounding the city of Durham, it flows northward to Chester-le-street, and then inclines a little towards the east, till it falls into the sea at Sunderland. The Tees finds its source in the same wild range of moors which give rise to the Wear, but considerably to the south of that river. Its course is nearly parallel to it; at first it rather inclines to the south-east, but when it reaches below Darlington, it turns abruptly to the north-east, and falls into the sea below Stockton. Teesdale, through which it flows, presents a long winding stripe of fertile land, surrounded with some of the wildest districts in the kingdom. Below Rokeby, the Tees receives the Greta from Yorkshire. To the northward of the Wear, in the same range of moors, the Darwent takes its rise; at first it pursues an easterly direction, but afterwards inclines more to the north as it approaches the Tyne, into which it falls a little above Newcastle. The rivers of Durham are not of very much advantage to its internal navigation; though the Tees might be rendered much more so than it is at present. A little below Stockton its navigation is very tedious, and often difficult, by reason of an extraordinary peninsula; for though the neck of land between the two parts of the river is only 200 yards, yet the course of the river is above 2 miles. As, however, an act of parliament has been obtained to make a cut across the narrowest part of the peninsula, and the work is actually begun, it is to be hoped that this impediment will soon be removed.

In this county there are some very large estates; but the most common rentals are below L.1000 a-year. The tenures are freehold, copyhold, and leasehold; the southern part being mostly freehold. A third part of the county is supposed to be of ecclesiastical tenure: they are considered as copyholds of inheritance. If the copyholder, however, die with the legal estate vested in him, the estate will go to the heir-at-law, as in the case of no will in freehold, except that the widow, instead of her thirds, is entitled to the whole for her life. The church leases are either for twenty-one years or three lives. Other leases are for three, five, or seven years, a few for twelve or fourteen; and many farms are let to tenants at will. The largest farm in the county does not exceed 1000 acres. There are a considerable number from 150 to 400; but the greatest part of the county is divided into farms from 150 to 50 acres. The best grazing pastures in the middle and eastern parts of the county let from L. 2 and L. 3 per acre; in the western, for 30s. and 50s. Arable land lets considerably lower. Of the houses of proprietors, Raby Castle, the seat of the Earl of Darlington, is an ancient, magnificent, and noble edifice; and Lumby Castle, belonging to the Earl of Scarboroug; Auckland Castle, the episcopal palace of the Bishop of Durham; and Brancepeth Castle, are also remarkable structures. Of the other buildings in the county, some of the bridges only deserve particular notice or description: Wear Bridge, over the Tees, is very singular in its construction; it is a wooden bridge, laid upon iron chains, which are firmly fixed in the rocks on each side of the river. From rock to rock the width is about 70 feet. In order to keep the bridge steady, and to prevent its vibrating, chains are also fixed on both sides, at the distance of about a third of the length of the bridge from each end; and the ends of these chains are fastened to the rocks. Although the iron bridge over the Wear, at Sunderland, has been already described under the article Bridge, yet a very brief account of it may not improperly be given here. It was built in 1796 and 1798, from a model upon a new construction, of uniting hammered iron with cast iron. The arch is a segment of a circle, the span of which is 236 feet, and the versed sine 34 feet. The breadth of the passage on the bridge is 32 feet: the height from the river, at low water, 100 feet; so that vessels may sail under it without striking their masts. It cost in building L. 27,000; and the average yearly amount of the tolls is L. 2030. The weight of cast iron employed in it is 214 tons; of malleable iron 46 tons: in all, 260 tons.

Durham is more distinguished for its grazing than agriculture. Its arable husbandry. The produce of wheat upon good land cannot be estimated higher than between twenty and thirty bushels per acre. As barley is seldom grown, except upon soils drest kindly, the produce of it is larger, viz. from thirty to forty bushels. Oats are grown on a great variety of soils; and as they also form the principal grain-produce of the western or moory part of the county, the average return per acre varies very much; probably it may be estimated at from twenty to forty bushels. Of beans, from fourteen to 20 bushels. Pease seldom succeed, and their produce cannot be rated higher than from eight to twelve bushels per acre. The produce of the hay-lands is not great; some indeed yield two tons of hay per acre, but in general the produce is below half a ton. The woodlands are not of any considerable extent; and though the soil in many parts is peculiarly adapted to the oak, this tree is seldom met with. The ash is much more common. The banks of some of the rivers, however, are adorned with timber. As the materials for making roads are good and abundant, the roads in this county are in general excellent, except in the western parts, where the township roads are narrow and ill-constructed.

Tees water has long been famous for its breed of cattle: They are of the short horned kind. The first attempt to improve them, was by introducing a bull from Holland; but this did not succeed. Mr Bakewell's mode was then followed, and, by judicious selection and crossing, they have been brought to a high state of perfection. Many of them have been remarkable for fat
The celebrated Durham ox was bred by Mr. Charles Collins of Kellon, in the year 1796. His form in every respect was nearly perfect; and as he shewed an early disposition to take on fat, great attention was paid to him. At five years old he was deemed so surprising an animal, that he was purchased to be exhibited as a show for £140, and soon afterwards £2000 were offered for him. He was killed in 1807; and, notwithstanding his being carried so much about for exhibition, yet he weighed upwards of 180 stone, 14 lb. to the stone. The lower parts of this county were formerly remarkable for their large breed of sheep: They were, indeed, the largest in the kingdom; many of them weighing from 50 lb. to 60 lb. the quarter. Some of them were nearly the height of a Shetland pony. But these sheep fell out of repute, when the Tees water farmers (who are the principal and most intelligent graziers in the county) turned their attention to Mr. Bakewell's breed, which is now the prevailing and favourite one in this part of the county. Besides these, however, there are heath sheep, which are distinguished by their black and mottled faces, black legs, and coarse wool. They are mostly found in the western district, on the borders of the moors. Their wool is long and coarse; the average weight of it about 4 lb. In the south-east part of Durham, as well as in the opposite district of Yorkshire, a breed of horses has long been famous, known by the name of Cleveland bays. They are supposed to be the original stock, from which the old English coach horse, stronger hunters, and road horses spring. They are remarkably good draught horses. Their form is very compact; their legs short and sinewy; and they are remarkably strong and active, frequently going sixty or seventy miles for coals or lime in twenty-four hours.

The botany of Durham affords several rare and beautiful plants, among which the burnet rose and the gentiana verna may be particularly enumerated. They are both met with in the neighbourhood of Winch Bridge. The latter, till it was discovered here, was not known to exist in Great Britain. But this county is more interesting to the mineralogist than to the botanist, as its mines are various and valuable.

The mineralogical districts are pretty well distinguished. In entering the county from the west, we immediately meet with the lead district, which stretches the whole breadth of it in this part, and extends to the east, as far as a line drawn from Allerdaleford nearly to Barnard Castle. When we pass this line, we enter on the coal district, which is more irregular in its form. Interposed between it and the sea, at least from Morton, a little to the north of Whitburn, is the principal limestone district. There are also other limestone districts: on entering the county from the south, at Piercebridge, we meet with it. Another lies farther north, on the ridge extending from Houghton to Aykley. Limestone is also found in the lead mine district.

The coal district occupies a space of twenty-two miles in length, and eleven and a half in breadth, and contains about 160,000 acres. The collieries are divided into "water sale" and "land sale": the former occupy about one-third, the latter two-thirds of the district. As, however, there are several parts in which no coal is found, or at least where it is either thrown out by dikes, or lies so low as not to be workable, the actual district of workable coals cannot be estimated to occupy more than 160,000 acres. The strata are very various in thickness, and in the quality of the coal. The land sale collieries lie in the south and western parts of the district, the water sale in the northern parts. It is calculated, that in the water sale collieries 1,333,000 chaldrons are wrought annually, which employ 701 men; and that in the land sale collieries 147,080 chaldrons are wrought, which employ 382. The kelleymen employed on the two rivers of Tyne and the Wear are 3257; so that the total number of chaldrons is 1,480,080, and the number of men employed is 10,630. It is calculated, that if the seamen who navigate the collieries which sail from Sunderland are taken into the account, the number of men employed in the coal trade on the river Wear are 15,000; and their families being computed at 11,000, there will thus be 26,000 persons supported by the coal works. As each chaldron of coals weighs 28 cwt., and a cubic yard of coal weighs a ton, there are 1,806,200 cubic yards wrought yearly for exportation, which occupy 112 acres. The average thickness of the workable seams is about five yards. The strata seldom lie horizontally, but generally at a small angle; and whatever the angle of inclination in one seam may be, let there be ever so many, they have all the same inclination. The fall dip is generally in a south-westerly direction. The dikes are divided into up-cast dikes and down-cast dikes, as the strata are cast up or down. The gut of the dikes is mostly filled with clay. The most remarkable dike is the whinstone dike, upon Cockfield dale: it runs nearly in a south-easterly direction: it is a "down-cast" to the north, of three fathoms. The breadth is seventeen yards, which is occupied by whinstone, that appears to have been in a state of fusion when it filled up the fracture. This is inferred from the appearance and nature of the coal, to the distance of some feet on each side of it, which is turned into a sooty substance, and becomes cinder as the distance from the whinstone increases. By degrees, however, it assumes the natural appearance of coal, and possesses all its proprieties. This takes place completely about fifty yards from the whinstone. Considerable quantities of ore of sulphur, of a beautiful bright yellow colour, and of an angular form, is found on the under surface of the stratum, lying on that part of the seam which is converted into cinders. The water burns clean without smoke, and affords a durable heat. In a dike somewhat similar to this, near Durham, some small quantities of lead ore have been found. The coals are brought out of the pits on machines drawn by steam; and from the pits to the water on waggons, which run on iron railways. It may not be improper here to notice an ingenious contrivance by the late Mr. George Dixon of Cockfield, in this county, for conveying coals, or other bodies of nearly the same specific gravity, by water without boats: "The specific gravity of coals not being much greater than water, he calculated the declivity necessary to give water a sufficient force to overcome the excess of weight that an equal bulk of coals had over an equal bulk of water, and laid a cut made upon Cockfield Fell, about four feet wide at top, and three feet deep, with such an inclination as to give the water the necessary velocity. When a cart load of coals was put into it, they swam, or were carried gently by the water into a reservoir, or standing pool, at the lower end, and deposited in proper vessels, to be drawn out as they were filled."

Lead appears to have been wrought in this county at a very early period. In the neighbourhood of Eggleston, in Teesdale, there are lead mines which have been wrought from the time of Edward VI. Various ancient workings have also been traced here, which, by
the different implements found in them, are supposed to have been wrought by the Romans. The lead mines, as has been already noticed, lie principally in Teesdale and Weardale. The ore is mostly found in veins. Where the adjoining strata consist of limestone, the ore generally produces a considerable quantity of metal; but where the adjoining strata are freestone, indurated argillaceous earth, which are called hence "plate beds," there is little metal in proportion to the ore. Of the different strata of limestone, that which is called "the great limestone," and which is seventy feet thick, has probably produced more ore than all the other strata together. There are generally about eighty-six lead mines worked in this county: Of which, in 1809, four were in Derwent; twenty in Weardale on the north side of the river, fourteen on the south side of the river; and forty-eight in Teesdale. The rent paid to the proprietors is generally one-fifth of the ore. The number of people employed has not been accurately ascertained. Their earnings are about L 40 a-year on an average, each man. Thirty-two cwt. of clean ore generally produces 20 cwt. of lead. The proportion of silver varies much; on the average, 22 ounces are produced from each ton (22 cwt.) in Teesdale. If a ton will not yield 8 ounces, it is not worth working. In Derwent there are four small mills, in Weardale three, and in Teesdale five. In the parish of Middleton, which extends nearly twenty miles from west to east, and between two and three from north to south, nearly the whole of the northern half is one series of lead mines. As the district is very mountainous, the mode of clearing them of water, called hushing, is frequently practiced. These "hushings" frequently raise, and discolor the water of the Tees, destroying its fish in great quantities.

In the western parts of the coal district, great abundance of iron ore is found; and tradition reports, that the Danes wrought it. It certainly appears to have been smelted at some remote period, from the immense heaps of iron slag which are found in various places. They were certainly very regularly and extensively wrought in the middle of the 14th century. In the lead-mining district, a few miles to the north of Stanhope, there is a large quarry, from which grey or freestone millstones, of a very superior quality, are procured. The bed of stone is 21 feet thick; but not more than half of this consists of real millstone. Above it lies a seam of finer freestone. About 40 millstones are sold on an average in the course of the year. What are generally called Newcastle grindstones are got at Gateshead fell in this county. They have been wrought for a great number of years. Some are cut as large as 76 inches in diameter, and 14 or 15 inches thick. A cubic foot of them weighs 1 cwt. 1 qr. 14 lbs. Five thousand chaldrons, each chaldron weighing 14 cwt. are made annually. In times of peace, the greatest demand for them is from Holland and France. Of the various kinds of freestone found in different parts of the county, that found at Heworth is most deserving of notice. It is of an open porous nature, and stands the extreme heat of the glasshouse furnaces better than any other stone or bricks. In the western parts of Durham, grey slate for roofing is abundant. What is called silver sand, and is used in the manufacture of the finer kinds of glass, has been discovered at Seaham.

Limestone. But next to coal and lead, limestone is the most abundant in Durham. The positions and limits of the different limestone districts have already been pointed out. In Weardale, near Frosterley, a limestone is found that takes a fine polish, and the colours are so beautifully variegated, that it is frequently used as marble for chimney-pieces; at Pallison also, several strata of limestone have been lately discovered, which approach still nearer the quality of marble: they are clouded with all the varieties of brown, from a dark brown to a cream colour. This limestone takes a very fine polish, stands any weather, and will not fly with heat; there are four strata of this fine limestone, each three or four inches thick; they lie near the bottom of the quarry; above them is lime of the common quality. For the purposes of agriculture, it has been found that the lime from the quarries to the eastward of the coal district, differ in their effects from the lime brought from the quarries to the westward of this district: the former, when laid on the land in heaps, and suffered to lie some time before it is spread, renders the ground under it unproductive; and hence it is called, "burning lime;" whereas the other lime produces no such effect, and is called "mild lime." These limes have been carefully analyzed by Sir Humphry Davy and other chemists; and the result is, that the limestones to the east of the coal district, that is, the hot or burning lime, contain a large portion of magnesia; and those to the west of the coal districts, called mild lime, are perfectly free from magnesia. The purest of the mild limestone contains 96 of carbonate of lime, and only 4 of residuum; and the worst of the burning lime contains only 44 of carbonate of lime, 42 of carbonate of magnesia, and 14 of residuum. The bad effects on the land were uniformly found to be in proportion to the quantity of magnesia which each contained. According to Mr Marshall, the limestone of Sunderland contains 97 of carbonate of lime. This limestone is of a lightish grey colour; the rock near Sunderland, out of which it is wrought, is upwards of 50 feet high; it is covered with 10 feet of pale clay; there are no regular seams; but it is composed of huge blocks; the interstices are filled with a species of marl.

About thirty years ago, a salt spring was discovered. Salt spring, in an engine pit, constructed for drawing water out of the coal mines near Birtley. As it mixed with the fresh water in the same pit, it would probably have remained unnoticed, but for an accident which happened to the boiler, the bottom of which suddenly dropped. On examining it, it was discovered to be corruded, and encrusted with a large quantity of strong salt. On this the workings were examined, and the springs were found to be confined to a stone drift, that had been driven 200 yards in a north-east direction into the mine. No trace of it is detected any where else, though the pit, and every other near it, have been excavated, both above and below it many fathoms. The depth of the spring is about 150 yards. It is conveyed to the bottom of the pit, whence it is raised by the colliery steam-engine. The spring has never been known to vary, and is as strong now as when first discovered. About 1100 tons of salt are made annually. It produces about 20,000 gallons per day, which is four times stronger than any sea water. At Butterby, near Durham, in the bed of the river Wear, is a spaw, arising from a spring of water, strongly impregnated with salt and sulphur. From the circumstance of its being mixed with the fresh water of the river, it is difficult to ascertain what quantity of salt it holds in solution; but, on several trials, it has produced double the quantity obtained from sea-water. It is much resorted to for its medical qualities. Dore'sdale spaw is sulphureous; it
was discovered, in 1769, in searching for coal. The spring burst forth, with a strong sulphureous smell, at the depth of 24 yards, after boring through red free- stone and whinstone. To the south of Hartlepool is a chalybeate spring, covered every tide by the sea. It is impregnated with a small degree of sulphur;—a gallon yields 120 grains of sediment, in which there appears to be also a considerable portion of lime. In the bed of the river Tees, near Barnard Castle, a sulphu- reous water springs from the crevices of the rocks. It is of the same quality as Harwich water, used for the same diseases, but not so strong.

There are a considerable variety of manufactures in Durham, particularly in the northern part of the coun- try. At Smalwells, anchors of all sizes are made, as well as other kinds of iron work for shipping. At Winlaton Mills, they manufacture files, edge-tools, cane- bills for the West Indies, &c. At this place there is a slitting mill, a mill for grinding edge-tools, and a tilton- forge, which makes 480 strokes in a minute; these are all driven by water. There are several founderies for iron and brass, at Gateshead, near Chester-le-street, at Sunderland, Darlington, &c. On the banks of the Tyne, near Gateshead, and in the vicinity of Sunder- land, great quantities of copperas are made. Formerly salt works at South Shields were very numerous; but latterly their number has much de- creased. There are in the county three works for the manufacture of coppers, one on the Tyne, and two on the Wear. Cotton goods were made till within these few years at Durham; but the manufacture is now laid aside. Darlington is famous for huckaback, diapers, sheetings, &c. which employ 500 looms. Mills for spinning flax were invented here. There are also mills for dressing chamois leather, and for grinding and polishing spectacle glasses. South Shields, Sunder- land, and Stockton are the principal ports in the county; the first has risen into great consequence and wealth within this last half century; since 1740, only four ships belonged to it, amounting to 800 tons; now there are between 40,000 and 50,000 tons of shipping. The number of ships built here annually, on an average, amounts to upwards of 30. Sunderland has also greatly increased in size and commerce. The principal trade, both from this port and South Shields, besides coals, is to the Baltic, and, in time of peace, to Holland. Corn and lead are the principal exports from Stockton.

There are some interesting natural curiosities in the county of Durham. About three miles from Darlington are cavities in the earth, called kall kettles, the ori- gin of which is unknown. Some suppose them to be shafts of old coal works, but this is not likely, as their diameters run from 75 to 114 feet; the depth of the largest is only 19 1/2 feet; and that of the smallest 54 feet. From the probable derivation of the name kall, the ancient British for salt, and kiddle a dam, some imagine them to have been salt pits. About five miles to the north of Hartlepool, is a singular and romantic cluster of rocks, called the Blackhall; some run many yards beyond the light of day; others are open, and supported by natural pillars, which in some places resemble the towers of a cathedral; in other places, the rock is so perforated, as to resemble a fine pointed arch gate- way. Marston rocks, between Shields and Sunderland, are much visited: it is an enormous craggy mass, detached from the coast by the violence of the sea; there is a large opening in the body of the rock, through which boats sail. The quantity of manure left by the sea-fowl which frequent it, is so considerable, as at the expiration of every five or seven years to be generally sold for L.100.

Roman antiquities are not uncommon: near Lanches- ter is one of the most perfect in the kingdom, the Glan- novita of Antoninus' Itinerary; the form is oblong, and it measures 174 paces from north to south, and 160 from east to west, within the walled. At Binchester there is another station, the Vinosium of Antoninus; but it is much less perfect than that at Lanchester.

At the period of the invasion of the Romans, Dur- ham was included in the country of the Brigantes; and on the conquest of Britain, it formed part of the divi- sion, Maxima Cesariensis. In the time of the Saxons, it was part of the kingdom of Northumberland. From the circumstance of its not being mentioned in Domes- day Book, it is supposed at this period to have been in possession of the Scots, or at least in such a disturbed state, as not to be safe for a survey. It is a county palatine, the privileges of which it is supposed to have obtained in the time of St. Cuthbert. Many of the ori- ginal very extensive privileges of the Bishop are now taken away, but he is still in possession of great power. He either acts as lord-lieutenant of the county, or appoints one. The sheriff is appointed by him; he is perpetual chancellor in his territories, all tenures of land originate from him, all estates to which no title can be made escheat to him, and the admiralty jurisdiction belongs to him. Durham sends 4 members to parlia- ment, two for the county and two for the city; but neither were represented till the reign of Charles II. By the returns of the population act in 1811, it appears that the

Inhabited houses were .......... 29,083
The families inhabiting them ...... 59,288
The houses building .......... 152
The uninhabited houses .......... 890
Families employed in agriculture .. 10,288
Do. in trade, manufactures, &c. .. 17,094
Do. not comprehended in the preceding ..
classes................................ 11,906
Males ................................ 83,671
Females ................................ 93,964
Total population ........... 177,625
Do. in 1801 .................. 165,700
Increase ................................ 11,925

DURHAM, CITY OF, is in the ward of Easington, 260 miles north from London. Its situation is particu- larly striking and picturesque; indeed a more singular position for the capital of a county can hardly be imag- ined. It is situated on a rocky eminence rising near the centre of the county, and almost surrounded by the rivers Wear, the banks of which here are beautifully and richly fringed with wood. The city descends in steep winding streets to its three bridges, which termi- nate in long suburbs. From all the neighbouring points of view, its appearance is grand and imposing, its public edifices displaying a great degree of magnificence; but when we enter it, much of the grandeur with which it strikes us at a distance is lost; for in general the houses are old, inconvenient, and dirty, and the streets narrow, winding, steep, and extremely incom- modious. The majestic cathedral and stately castle stand on a high circular hill; these, with the streets called the Bailes, are included within the ancient city walls. The situation of the cathedral adds much to its grandeur. The base of the rocks which support its west end, are washed by the Wear; and from the square, called the Palace Green, by which it is general-
Durham.

ly approached, the whole of its north front is at once beheld. It was begun to be built in the year 1095. The centre tower was erected between the years 1233 and 1258. No material additions were made to it since, till the year 1776; at that period great improvements were begun, which are still going on. The cathedral is interesting to architects, as affording "a most instructive series of examples, illustrating the gradual change of style which took place during the reigns of the three first Henries, till by degrees the pointed had completely superseded the semicircular arch; and the heavy clusters of the Norman pillars were polished into the light shafts of the early English." There are several ancient monuments in it; and those of the venerable Bede, Lord Neville, and Bishop Hatfield, are particularly deserving of notice. The Episcopai throne, chapel of 9 altars, library, &c. are also worthy of attention. On the north of the cathedral, there is a large open area, called the Palace Green, on which the castle stands; it is the residence of the Bishop whenever he visits Durham. The views from its upper apartments are singularly commanding, taking in the whole of the city, and the windings of the Wear through a fine county to a considerable distance. It is not known at what period it was built, but probably before the reign of William the Conqueror. The Keep or Tower is the most ancient part; it is an irregular octagon. At present it is a mere shell, but appears originally to have contained four stories besides the vaults: the perpendicular height of the mount on which it stands is 44 feet; round it three pleasant terraces have been formed each 10 feet wide, and communicating with one another. As the buildings which compose the castle were erected at different periods, there is no uniformity of taste or style in them. Out of its north gateway the prison is formed, the anterior accommodations of which have been lately much improved. There are three bridges over the Wear, one of which, called the Bank's Bridge, is rather an elegant structure. Besides these there are six parish churches, exchequer, law courts, college, guildhall, infirmary, &c. From the Palace Green is an avenue that leads to the public walks on the banks of the river; these were made and are kept in repair by the dean and chapter; they accompany the winding of the stream, and command some beautiful views of the city and cathedral. On the one hand, the banks are rocky and abrupt, while on the other they slope gently to the river, covered with wood. "The combination here of trees and buildings, water and rock, home sylvan scenery, and fine distances, is at once beautiful and grand."

Durham sends two members to parliament. The right of election is vested in the corporation and freemen, who at present amount to about 1200: the city is governed by a mayor, twelve aldermen, twenty-four common-councilmen, recorder, town-clerk, &c. It is deemed one of the best bishoprics in England; and the livings in the bishop's gift, the richest. The present endowment for a deanship was established by Henry VIII. with twelve prebendaries, twelve minor canons, &c. During the protectorate of Oliver Cromwell, an attempt was made to establish an university here, but it was suppressed at the restoration, and the buildings, which are still called the college, were given to the dean.

The manufactures consist of woollen goods, such as shallows, tamnies, carpets, &c. The neighbourhood of the city is famed for large crops of mustard, which pay remarkably well, Durham mustard being in great request all over the kingdom. At the end of March there is a fair, which lasts for three days, principally for cattle, sheep, and horses; there are also fairs on Whit-Tuesday, and on the 16th of September. Saturday is the market day. The population in 1811 was 6763. See Hutchin's History of Durham; Warner's Northern Tour; Granger's Account of the Agriculture of Durham; Bailey's Agriculture of Durham; Marshall's Review of the Agricultural Reports from the Northern Department of England; and Beauties of England and Wales, vol. v. (w. s.)

DURIO, a genus of plants of the class Polyadephia, and order Polyandria. See Botany, p. 287.

DURIOA, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 184.

DURSLEY, a town of England in Gloucestershire, is situated at the base of a steep hill, clothed with a fine hanging wood of beech trees. The town, which isirregularly built, consists of two narrow streets, crossing each other nearly in the shape of the letter T. The principal public edifice is the church of St James's, which is a large and elegant building. It consists of a spacious nave, side aisles, and a chancel, with a modern Gothic tower at the west end, and an elegant portal on the south. The old spire fell in 1699, during the ringing of the bells, and several persons lost their lives. In 1700, it was rebuilt at the expense of L.1000. The market house, which stands near the centre of the town, was built in 1738, and is wholly of free-stone. At the east end of it there is a statue of Queen Anne. "On the south-east side of the church-yard," says Mr Rudge, "some springs arise out of the ground like boiling water, in so copious a manner, as to drive a fulling mill at about a hundred yards distance below, and are never known to diminish in quantity. At their rise they cover a fine level gravelly bottom for about 15 feet square."

The cloth manufacture is carried on here to a great extent, by means of machinery, and cards are also manufactured for the clothiers. There is an extensive paper manufactory adjacent to the town. There is found in the neighbourhood a peculiar kind of stone, without any chip or slit, called trowe stone, which is at first soft, and afterwards indurates by exposure to the air.

The following is the abstract of the population return for the parish in 1811.

| Inhabited houses | 489 |
| Families that occupy them | 561 |
| Families employed in agriculture | 68 |
| Do. in trade and manufactures | 365 |
| Males | 1151 |
| Females | 1429 |
| Total population | 2580 |


DUSKY BAY. See Zealand New.

DUSSELDORF, a town of Germany, and recently the capital of the grand duchy of Cleves and Berg, is situated on the Rhine near its confluence with the river Dussel. The streets are regular, clean, and spacious, the houses lofty, and the public buildings numerous and handsome. The principal objects of curiosity, are the hotel de ville, the equestrian statue of John William, Elector Palatine, by Grippelo; the hotel of the former government; the barracks, which were built by the Elector John William, and held eight battalions, each of which has its particular church; the collegiate church, containing a marble monument of the Duke John; the cideon church of the Jesuits, which is the
At the distance of about half a league from the town stands the convent of La Trappe, where the religious manufacture and sell snuff-boxes with cyphers, which are held in high estimation. Cromford and its manufactories, the fine view from the summit of the Grafenberg, and the cavern in the mountain of Klutter, are also worthy of being seen. At the distance of 4½ miles from Dusseldorf are the baths of Schwelm, which are much frequented in summer. The population of the town is 12,000.

SECTION I.

**History of Dyeing.**

5. **The perception of colour seems to be accompanied with immediate pleasure; and though the effect is probably heightened by association, it is so instantaneously produced, that we are only conscious of the pleasing emotion, and seldom think of searching beyond it for the source of our delight. Long before we are capable of analyzing our feelings, the eye is caught with the brilliancy of colour, and the splendour of illumination. Even the lower animals are not altogether insensible to the beauties of rich and variegated tints; and man in his rudest state, has always regarded colour as a principal constituent of ornament. Nor is it only in the judgment of the infant or the savage that colours rank high among the elements of beauty; in the most refined periods of human society, they retain an undiminished attraction, or rather acquire a more powerful influence by the cultivation of taste.** Among the several kinds of beauty," says Mr. Addison, "the eye takes most delight in colours. We no where meet with a more glorious or pleasing show in nature, than what appears in the heavens at the rising and setting of the sun, which is wholly made up of those different stains of light, that show themselves in clouds of a different situation. For this reason we
find the poets, who are always addressing themselves to the imagination, borrowing more of their epithets from colours, than from any other topic."—Spect. No. 412.

6. To this delight which we derive from the perception of colour, must be referred the origin of dyeing. The savage would naturally wish to recall the pleasure which he experienced from viewing the varied and delicate tints of the vegetable world, by transferring their colouring principles to objects less fleeting in their nature, and more frequently present to his sight. His first efforts would be rude and imperfect; and might consist in rubbing his body with the expressed juices of fruits and flowers, or in communicating a fugacious tinge to his simple articles of dress. His fondness for brilliancy and variety, would prompt him to make trial of different substances; and though many of his experiments, as they were guided by no fixed principle, might fail, some of them would succeed, and thus gradually lead to the discovery of useful dyes. Perseverance would supply the place of knowledge, and accident would sometimes disclose what ingenuity might never have found out. These remarks may even be applied to dyeing, after the art had attained a more advanced state, and when it might have been expected that science would have lent greater assistance to a subject so susceptible of being improved by inductive investigation. It has often been regretted, however, and not without reason, that almost every important discovery in the arts has been the offspring of accident, and that science has done little more than suggest some hints for improving what chance may have offered to human observation.

7. The origin of dyeing must, therefore, be referred to a period far beyond the records of authentic history. The art appears to have been cultivated by the Egyptians from the earliest times; but it is extremely probable that it passed to that people from the Hindoos and other inhabitants of India, who seem to have practised dyeing at a still more remote period. Indeed, almost all the arts and sciences have originated in that quarter of the globe; and though, on account of the political and religious institutions of the East, they never attained there any great degree of perfection, they gradually spread among other nations less fettered by prejudice, and more disposed to adopt whatever might be regarded as improvement. It is remarked by Major Renne, "that a passion for Indian manufactures and products has actuated the people of every age, in Lower Asia, as well as in the civilized parts of Europe: the delicate and unrivalled, as well as the coarser and more useful fabrics of cotton of that country, particularly suiting the inhabitants along the Mediterranean and Euxine seas. To this trade, the Persian and Arabian gulf opened an easy passage; the latter particularly, as the land carriage between the Red Sea and the Nile, and between the Red Sea and the Mediterranean, took up only a few days. It is highly probable, continues he, and tradition in India warrants the belief of it, that there was, from time immemorial, an intercourse between Egypt and Hindostan, at least the maritime part of it; similarity of customs in many instances, as related of the ancient Egyptians by Herodotus, (and which can hardly be referred to physical causes,) existing in the two countries."

8. The natural fertility of India, and the great variety of materials which it affords for cultivating the art of dyeing, were extremely favourable to its improvement. But religious prejudices, and the unalterable division in to 'east," soon imposed restraints upon industry; the arts became stationary; and it would seem that the knowledge of dyeing cotton was as far advanced when Alexander the Great invaded the country, as it is at present. Even at this day, the Indian processes are so complicated, tedious, and imperfect, that they would be impracticable in any other country, on account of the price of labour. European industry has far surpassed them in correctness of design, variety of shade, and facility of execution; and if we are inferior to them with respect to the liveliness of two or three colours, it is solely to be ascribed to the superior quality of some of their dyes, or perhaps to the length and multiplicity of their operations.—See Berthollet.

9. The Egyptians do not seem to have made any important additions to the knowledge of dyeing, which they borrowed from their eastern neighbours; and indeed little could be expected from the genius or industry of a people who were strictly prohibited by the principles of their religion, from changing even their most indifferent customs. It appears, however, according to Pliny, that they were acquainted with a mode of dyeing, very much resembling calico-printing. He mentions that the Egyptians began by painting on white cloths, with certain drugs, which in themselves possessed no colour, but had the property of abstracting or absorbing colouring matters; that these cloths were afterwards immersed in a heated dyeing liquor, of a uniform colour, and yet when removed from it soon after, that they were found to be stained with indelible colours, differing from one another according to the nature of the drugs which had been previously applied to different parts of the stuff.—See Plin. lib. xxxv. cap. ii.

10. From Egypt, the knowledge of dyeing seems to have been communicated to the inhabitants of Tyrus, to whom the art became indebted for the discovery of one of the most celebrated dyes known to the ancients. This species of dye, called the Tyrian purple, which was subsequently either lost or neglected, soon became an object of the most refined luxury, and contributed greatly to the opulence of that enterprising and industrious people. The circumstances which led to the discovery of it are very imperfectly known: but fiction has supplied the want of historical facts, and described its origin with sufficient minuteness of detail. According to one account, the merit of its discovery is due to a dog belonging to a certain Hercules. We are informed, that when this dog was accompanying his master along the sea-shore, who was then following the nymph Tyros, the animal seized one of the purpurae lying on the sand, and breaking the shell with its teeth, his mouth soon became coloured with the purple juice. The nymph having observed the effect, immediately expressed a strong desire to obtain a dress dyed of the same beautiful colour; and her lover, no less anxious to gratify her wishes, at last succeeded in discovering a method of applying it to cloth. The name of the nymph by whom the colour was first worn being Tyros, the dye itself was called the Tyrian purple.—See Cassiodorus, lib. 1.; Jutius Pollo, lib. 1. 4.

11. Others ascribe the discovery to the Phœnician Hercules, and affirm, that he afterwards communicated it to the King of Phæacia, who immediately after began to wear purple, and was so jealous of its beauty, that he forbade the use of it to his subjects, reserving it exclusively for the robes of royalty. It is probable, however, that this colour was first discovered at Tyre,
and on that account received the name of Tyrian purple; more particularly, as the epithet Sarraus, from Sarras, the ancient name of Tyre, was frequently applied to it.

12. The more ancient writers differ no less with respect to the time when the Tyrian purple was discovered, than with respect to the circumstances which led to its discovery; some stating it to have been 1500 years before the commencement of the Christian era, and others nearly a century later, at the time Minos reigned in Crete. Frequent mention is made of purple in the books of Moses; but whether the colour alluded to was the Tyrian purple, or communicated by a different process, is difficult to determine. At any rate, the frequency (Exod. xxv. 6; xxvi. 1.) with which it is mentioned, implies that some method of dyeing purple was common among the Israelites soon after they settled Egypt, which was nearly about the period already stated (1401 B.C.) The great antiquity of this colour is also confirmed by the testimony of Homer, who represents his heroes to have been dressed in purple.

13. This colour was so highly valued by the ancients, that it was either consecrated to the worship of the Deity, or conceived to be fit only for the garments of royalty. Under the Mosaic dispensation, the stuffs for the service of the altar, and the habits of the high priests, were enjoined to be of purple. The Babylonians devoted this colour to the dress of their idols, and most of the other nations of antiquity seem to have done the same thing. Pliny informs us, that it was used by Romulus, and by succeeding kings of Rome, as well as by the consuls, and first magistrates under the republic. The Roman emperors at last appropriated it entirely to their own use, and denounced the punishments of death against those who should dare to wear it, though covered with another colour. This absurd and tyrannical restriction confined the dyeing of the Tyrian purple to a few individuals; and in a short time the knowledge of the process was completely lost. In the twelfth century, neither the shell fish which furnished the dye, nor the methods which the ancients employed to communicate to cloths the rich and beautiful purple which it afforded, were at all known; and on the revival of learning, it was even suspected by many, that the accounts which have come down to us respecting this celebrated colour, were entirely fabulous.

14. Notwithstanding the very high esteem in which the Tyrian purple was held by the ancients, and the great encomiums which have been bestowed on it by many of the moderns, the loss of it is perhaps scarcely an object of regret. The shell fish which furnished the purple dye probably exist now, says Berthollet, in as great abundance as formerly. They have been so accurately described, that they may be recognized; and, in fact, Thomas Gage informs us, that shell fish have been found near Niceya, a small Spanish town in South America, which possess all the properties described by Pliny, and other ancient writers. These shell-fish, it appears, are at present used in dyeing cotton on the coasts of Gungaquiil and Guatimala. Cole, in the year 1669, discovered some of them on the English coast, and Plumier found a species of them at the Antilles. Reaumur has made many experiments on the wholes which he obtained from the coasts of Poitou, and Duhamel has minutely examined the colouring liquor of the purple shell fish which he found in great abundance on the coast of Provence. He observed that this liquor does not take a purple colour without the action of light, a circumstance which Reaumur had before remarked respecting that of the whelk; that though at first white, it becomes of a yellowish green, which deepens to a sort of blue; that it afterwards reddens, and in less than five minutes becomes of a very fine deep purple. In all these respects, the colour produced possessed the characters of the ancient purple. If this method, therefore, of dyeing purple is no longer practised, it is not on account of our ignorance of the process, but because we are acquainted with more beautiful, as well as much less expensive dyes; though, as Dr Bancroft remarks, the purple afforded by the shell-fish in question, may still be applied with advantage in topical dyeing, for which but little colouring matter is required.

15. The art of dyeing seems to have made but little progress among the Greeks; a fact which must undoubtedly be ascribed to the little estimation in which the arts that contribute to convenience or luxury were held by that warlike and high-minded people. Public opinion placed the fine and the useful arts at an immense distance from each other; for while the highest glory was connected with the former, the latter were degraded among the dishonourable and servile employments. Accordingly we find, that though the more opulent inhabitants of Athens preferred coloured clothes, the dress of the common people was made of cloth which had received no dye. The art of dyeing linen appears to have been unknown in Greece before Alexander the Great invaded India; where, according to Pliny, his captains, in skirmishing on the banks of the Indus, first saw, to their astonishment, the enemy changing the ensigns of their vessels, and suddenly displaying others of different colours. Even the dyeing of woollen stuffs seems to have made little progress at that time, as the same author, after declaiming against the luxury of his contemporaries for wearing clothes dyed of colours which rivalled those of the finest natural flowers, observes, that none of these flower colours were in use during the time of Alexander. It is probable, however, that the companions of that conqueror brought back from Persia and India some information respecting the rich dyes employed in those countries, which they afterwards diffused among their countrymen.

16. The Romans borrowed almost all the knowledge of dyeing which they possessed from the Greeks, together with the same contemptuous notions with regard to the art. The sentiments of the Greeks and Romans in this respect, afford a remarkable contrast to the more liberal and enlightened views of the present day, and furnish one of the most striking characters by which the philosophy of the ancients is distinguished from that of the moderns. The ancients appear to have undervalued everything that contributed to domestic comfort and enjoyment; and while they professed the most enthusiastic regard for the public good, to have forgotten that the grand aim of all patriotism ought to be the promotion of individual happiness. They accordingly degraded the useful employments, and reserved their esteem for arts whose productions could seldom be brought in contact with ordinary affairs. The moderns, less actuated by
DYEING.

17. Next to the Tyrian purple, the Romans valued most highly the colour obtained from the kermes, or coccius ilicis. Pliny mentions that this dye was sometimes employed with the colour of murex and buceinum, (the shell-fish which gave the Tyrian purple) in producing a sort of purplish crimson, called by the Romans hygginum. He states, that this substance was brought from Galatia, or from the neighbourhood of Emerita in Portugal, and that the latter was reckoned most valuable. We learn also from Pliny, that the kermes, like the Tyrian dye, was at last appropriated for dyeing the imperial robes, though it must have yielded a colour greatly inferior to that which is obtained from it at present, as he insinuates that it was not durable. This last circumstance would lead us to suspect, that at that time the ancients were unacquainted with the use of alum as a mordant, though such an opinion is rather discon- nected from other facts stated by Pliny. In his 35th book, chap. xv. De Sulphure, Alumine, et gencrichus corum, §c. he describes several species of alum; that of these the island of Cyprus afforded two, one white, and the other black; and that though their colours differed but little, their uses were extremely different. The white alum, he adds, is principally used for dyeing wool with clear and bright colours; the black, for dyeing brown and dark colours. He afterwards notices five different kinds, and concludes with observing, that all the different kinds of alum were possessed of an astringent property. Beckmann has endeavoured to prove that the alum of the ancients was totally different from the triple compound to which the moderns apply the term alum, and consisted in a combination of sulphuric acid, with either iron or copper, or perhaps zinc, formerly known by the names of green, blue, and white vitriols. In support of his opinion, he mentions that the Greek and Roman writers mention only native alum, a salt of very rare occurrence; while no account is given of any Work for its artificial preparation, except one in Spain, noticed by Pliny, which was intended to crystallize the sulphates of copper or iron. But the passage already referred to, renders it extremely probable that the common sulphate of alumine was included among the substances to which he gave the appellation of alumum; though it is no less certain, that the sulphates of iron and copper were classed along with it, as he expressly states that two of them produced a black colour, with galls, and the peels of the pomegranate.

18. Besides the Tyrian purple, and the various shades of red from the kermes, the Romans were acquainted with several other colours. It was customary among them, from the earliest times, for newly married women to wear a yellow veil, a colour which was confined entirely to matrons; and those who were employed in the games of the circus were distributed into divisions, each of which was dressed in an appropriate colour. The colours mentioned are color prassius, green; rusfus, orange; venetus, grey, or perhaps a light blue; and white. Some idea may be formed of the qualities of these colours, by enumerating the substances with which they were procured. It is difficult to give a complete account of them; but the following seem to have been the most important: madder, woad, the roots of anehusa tinctoria, or alkanet; the genista tinctoria, or dyer's brome; gallnuts, pomegranate peels, elder bark, the rinds of walnuts, the bark of the walnut tree, and the pods of the Egyptian acacia. No account, however, has been transmitted to us, either by Greek or Roman writers, respecting the methods in which these substances were employed, or of the mordants that were used along with them to give fixity to their colouring principles.

19. The ancients were ignorant of the use of soap, a substance which gives the moderns a decided superiority over them in preparing the stuff for the reception of the dye. In order to remove the grease from the wool, and wash linens, they employed a plant called by Pliny radix—

cula, and by the Greeks εργελον, supposed to be our sa- pounaria, or soap-wort. Pliny notices another plant which was used for the same purpose. Homer represents the Princess Nausicaa and her attendants washing their linen clothes in the ditches, by trampling on them with their feet.

20. Whatever knowledge of dyeing the ancients possessed, appears to have been lost about the fifth century, a period when almost all the arts were forgotten, and scarce any traces of civilization remained in the western empire. A faint knowledge of the arts was, indeed, retained in Italy, and kept alive by occasional intercourse with the East, in consequence of the crusades; and also by the importation of various articles of luxury and refinement, which was made at that time by the Venetians from the same quarter. This importation continually afforded new materials for industry, and new objects for imitation, and gradually led to the revival of the arts in Italy. The knowledge of the methods of dyeing, as practised by the Greeks and Romans, was in some measure restored by the acquisition of chemical science, which now began to shed a feeble light over the objects of human industry, and attained a state of improvement probably not inferior to that in which it existed in ancient times.

21. From Italy, the knowledge of dyeing gradually spread itself through the other states of Europe. Archil is said to have been discovered at Florence about the year 1300, by a merchant of that city, who hap-
pening to observe that urine imparted a very fine colour to a certain species of moss, was induced to make experiments upon it, and thus learned the preparation of archil. In the year 1429, a treatise on dyeing made its appearance at Venice, of which an improved edition was afterwards published in 1510. This work, however, was very imperfect; and in order to render it more useful and extensive, Giovann Ventura Rosetti, overseer of the arsenal at Venice, resolved to travel through the different parts of Italy, and the neighbouring countries, where dyeing was practised, to obtain an accurate acquaintance with the various processes of the art, and reduce them under a systematic form. He accordingly carried his design into effect, and in 1548, published the result of his observations and enquiries under the assumed name of Pistola. This work united the different processes then employed, and, in the opinion of Bischoff, ought to be regarded as an important step towards the perfection which the art of dyeing afterwards attained, though, according to Hollar, it is but little entitled to attention. It is a curious fact, that it contains no account either of cochineal or indigo. Bischoff explains this circumstance, by supposing that neither of these dyes was employed at that time in Italy. Whatever uncertainty may exist with respect to the time when cochineal was first used as a dye, no doubt can be entertained, that long before the period at which Rosetti published his work, the properties of indigo were well known. Bischoff indeed conjectures, that the indicum of Pliny was not a dyeing drug, but a substance used as a paint, and very different from our indigo; and that the contract which was made in 1194, between the cities of Bologna and Ferrara, respecting certain duties to be levied at the former upon indigo, had a reference to the indicum of Pliny. Dr Bancroft, (Philosophy of Permanent Colours, vol. i. 242,) however, has shewn the identity of these substances, from the exact coincidence of the properties of indicum, as described by Pliny, with those of the modern indigo; and he quotes a passage from Caneparius, which proves that indigo was brought by merchants from India and Alexandria, and thence imported to Venice, when that city was the entrepot of Europe and the East. The statement of Caneparius also seems to correct a mistake committed by Berthollet, who mentions that the first indigo employed in Europe was imported by the Dutch from the East Indies. The fact is, that long before the Dutch had any intercourse with that country, indigo had been imported in considerable quantity from Egypt and Syria to Italy, and employed in dyeing. Bischoff also has established, by the most decisive evidence, that indigo was employed as a dye before the Dutch visited the East Indies. He informs us, that woad-dyers were recognized among the Germans as a distinct trade, so early as 1329, and that they were afterwards incorporated by charter with certain dyers from Italy and Flanders, under the name of Art, Woad, and Fine Dyers; that this body, soon after its establishment, excelled the jealousy of a more ancient corporation, the Black Dyers; and as indigo was employed by the former, the Black Dyers exerted themselves so successfully in depriving the use of it, that the Elector of Saxony, listening to their selfish suggestions, was prevailed upon to issue severe prohibitions against those who should employ it in dyeing. In the prohibitory edicts which were passed against it, it is described as a corrosive colour, and fit food only for the devil. These acts were passed between the years 1521 and 1547, which was a considerable time before the first voyage undertaken by the Dutch to the East Indies. See Indigo.

23. Though the knowledge of dyeing had now extended itself over the more civilized parts of Europe, the principles of the art seem to have been still in a great measure confined to Italy and Venice; a circumstance which contributed, in no small degree, to the prosperity of these states. Accident, however, has frequently led the way to important discoveries, and in some cases contributed more to the improvement of the arts, than the most refined speculation guided by experience. This remark is peculiarly applicable to the discovery of scarlet, one of the most brilliant colours known in dyeing. "The etymology of the term scarlet is involved in some obscurity. Ptolemy thought it of Celtic origin, and that it signified Galatian rubor. (See Antiq. Celt. p. 69.) But according to Beckmann, Silber asserts that scarlet is a German word, compounded of schor, fire, and lacken, cloth; while Rerske, on the contrary, derives the word in question from the Arabic scarab, meaning the kermes dye. See Bancroft.

23. Whatever be the origin of the term, the colour to which it was applied seems to have been known at a very early period. Beckmann quotes a passage from the Historia Celtrica Pontani, in which it is affirmed, that Henry III. of France conferred upon the Count of Cleves the Burgervaste of Nimeggen, on condition of his delivering to him annually three pieces of scarlet cloth, manufactured from English wool, (tres pannos scarlaticinos Anglo- nan.) The same author also refers to a work published in 1211, entitled, "Gervasiil Tiberiiensis obsi Imperialia at Ottomum IV. Imperatorem," from which he quotes the following observation applied to the kermes: "Vermiculus hic est, quo tincturum pretiosissimus regnum panni, sive serici, ut exami, sive lanae, ut scarlata."

The colour, however, to which the term that gave rise to our word scarlet, was then applied, was very different from the colour which now bears that name; the former having been obtained from the kermes, whereas the latter is procured from cochineal, and excited in brilliancy by the application of a particular mordant. The insect to which we give the name of cochineal was unknown in Europe before the discovery of America. When the Spaniards first visited Mexico about the year 1518, they observed that the native inhabitants of the country employed cochineal for communicating a colour to some parts of their domestic utensils, ornaments, &c. and also as a dye for cotton. They were so struck with its beauty, that an account of it was transmitted to the Spanish ministry; who accordingly, in the year 1523, ordered Cortes to adopt proper measures for increasing the produce of a commodity which appeared to be of the utmost value as a dye. The Mexicans are said to have employed cochineal as a dye long before they were visited by

* This is proved by the following passage from Caneparius, "Iaties est herba, que ante fiorum colligitur et sub mola tunditur, et facto ex ipa cumulo maceratur soli, mov in magnos globos redacta, et sub tecto locata aspergitur aqua, ut magis, potiusque maceratur, tunc edidit magnum fictorem et nigrescit, et sic preparatis iaties sit glisti diecutur idem est, percutitur ad finituras."—"The supposed of Caneparius," says Dr Bancroft, "that indigo was obtained from the iaties, or wood plant, seems to have been prevalent in this country, so late as 1640."
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Money, and to have used an aluminous mordant to give it fixity. It appears even that for a considerable time after the introduction of the cochineal into Europe, this was the only mordant employed in dyeing with it; so that the only colour obtained from cochineal at first must have been a crimson, which we learn indeed was the case, on the testimony of Cancarini (De Altramentibus, p. 191.) About the year 1630, it was accidentally discovered that the nitrate of tin possessed the property of exalting, in a very eminent degree, the colour of this drug, and converting it from a dull crimson to an intense and brilliant scarlet. Kanneal and some others inform us, that a German chemist, of the name of Kuster or Kuffer, having accidentally dropped a solution of tin by aquafortis into a decoction of cochineal, was the first who observed the singular effect; while Beckmann asserts, that we owe the discovery of scarlet to a Dutch chemist of the name of Cornelius Drebbel, who was born at Alkmaar, and died at London in 1634; and that Drebbel communicated the discovery to Kuffer, who was then an eminent dyer at Leyden, and afterwards became the son-in-law of Drebbel. Beckmann also states, that Kuffer soon after took advantage of the discovery, and reduced it to practice in his dye-house; and that the scarlet thus obtained was at first named Kuffer’s colour, and afterwards Dutch scarlet. A Flemish painter of the name of Kloock or Ghiek got possession of the secret, either directly from Kuffer himself, or by means of some hints which he had obtained concerning the process employed by the latter. Ghiek communicated the information which he thus procured to the famous Gobelins at Paris; and another Fleming, named Kepler, carried the secret to England about the year 1643. A dye-house was soon after established at Bow, near London, and hence the new scarlet was for some years called the Bow dye. See Baneroff, vol. i. p. 448.

24. About the year 1662, the Royal Society of London, then recently established, directed their attention to dyeing; and in order to promote the improvement of the art, desired Dr Haak to prepare a translation of the work, entitled, Phleths, which, as we have already stated, had been published about a century before in Italy. This translation, however, was never executed; but at that time Sir William Petty, in consequence of a request from the Society, laid before them “An Apparatus to the History of the common practice of Dyeing,” which afterwards appeared in Dr Spratt’s History of the Royal Society, and is perhaps the first original treatise on dyeing which has appeared in our language. Soon after, Mr Boyle gave an account to the Society of his experiments on colours; and towards the conclusion of 1664, the Society enjoined that “the way of fixing colours should be recommended to Mr Howard, Mr Boyle, and Dr Meritt.” This recommendation does not appear to have been productive of any useful discovery in dyeing, or even of any improvement of its processes; but it served to turn the attention of other members to the subject, and on the 11th of November 1669, “Mr Hook,” who was always distinguished by the ingenuity and originality of his views, “produced a piece of calico stained after the way contrived by himself, which he was desired to prosecute on other colours besides those that appeared in this piece.” (Birch, Hist. Roy. Soc. vol. ii. 401.) And accordingly, on the 9th of the following month, “he produced another specimen of staining with yellow, red, green, blue, and purple colours, which he said would endure washing with warm water and soap.” It was not to be expected, however, that, in the very imperfect state of chemical science at that time, a few random experiments could give much information to practical dyers, who had better opportunities of observing the result of fortuitous mixtures, and were equally well prepared to take advantage of whatever accident might present to their notice. We accordingly find, that for nearly a century afterwards, no important improvement in dyeing was suggested by men of science in this country.

25. In France, industry, which had languished during the administration of Richelieu and Mazarin, was revived by the fostering care of Colbert, and raised to a high pitch of pre-eminence among that of the other nations of Europe. That enlightened statesman, among other objects of his care, turned his attention to the improvement of dyeing. He invited the most skilful artists to settle in France, and afforded every encouragement to the establishment of manufactories in various parts of the country. In order to correct, as well as to prevent the frauds which were practised by dyers, he published, with the assistance of M. D’Albo, a set of regulations in 1669, and afterward in 1672, under the title of Instruction generale et pour la teinture des laines et manufactures des laines de toutes nuances, et pour la culture des drogues qu’on y emploie. This legislator first endeavours to show that dyeing is an object deserving public attention, from the additional value which it confers upon many of the articles of commerce. “If the manufactories of silk, wool, and thread, are to be reckoned among those which most contribute to the support of commerce; dyeing,” says Colbert, “which gives them that striking variety of colour, by which they resemble what is most beautiful in nature, may be considered as the soul of them, without which the body could scarcely exist. Wool and silk, the natural colour of which rather indicates the rudeness of former ages, than the genius and improvement of the present, would be in no great request, if the art of dyeing did not furnish attractions which recommend them even to the most barbarous nations. All visible objects are distinguished and recommended by colours; but, for the purposes of commerce, it is not only necessary that they should be beautiful, but that they should be good, and that their duration should equal that of the materials which they adorn.” The regulations of Colbert were intended, however, rather as restrictions to control, than as directions to instruct the dyers in the management of their operations. They admitted the former division of dyers “en grand,” who were confined to colours deemed permanent, and dyers “en petit teint,” who were permitted to dye only such as were fugitive; while they particularly specified the different substances which both were to employ in their respective processes. These restrictions, which were imposed chiefly with the view of guarding the public against imposition, would have been productive of still greater evils than those they were intended to obviate, had they not been easily eluded, and had not the government at the same time held out the promise of rewards to those whose experiments contributed to the progress of the art.

26. During the administration of M. D’Oray, the Theoretical opinion of Dufay.
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for the improvement of the art. Dufty, who was committed in drawing up this act, appears to have been the first who entertained just notions concerning the cause of the attraction of colouring matters to stuffs, particularly in those cases in which an immediate affinity subsists between them. Without this affinity, he stated, that the cloth in a dyeing bath would never acquire an intensity of colour greater than that of the liquor in which it was immersed, but share the colouring particles, by a mechanical division, equally between itself and the bath; a state of things which is by no means conformable with experience, as the stuff sometimes attracts all the colouring matter, and leaves the liquor in which it was dissolved perfectly limpid. "This seems to indicate," says Dufty, "that the ingredients have little attraction for the water than for the particles of the wool." He also observed the different degrees of attraction which different substances, as wool and cotton, exert upon colouring matters; but he appears to have had no just opinion concerning the operation of mordants, or those substances which are sometimes necessary to connect the colour with the stuff. His successor Hellot published an excellent practical treatise on the methods of dyeing wool; but all his theoretical notions were led astray by a very absurd hypothesis, which he seems to have adopted without the smallest proof. In all the processes of dyeing, he conceived that a sulphate of potash was formed; and that this salt, being sparingly soluble in cold water, and little affected by air or light, first diluted the pores of the stuff to be dyed, thus preparing it for the reception of the colouring particles, and afterwards wedged these particles so closely together, that it became impossible for them to make their escape. This hypothesis, which was neither supported by fact, nor countenanced by sound reasoning, was admitted without proof, and regarded for a considerable length of time as a true explanation of the cause of the adhesion of the colouring matter to the stuff. "I believe," says he, "it may be laid down as a general principle in the art of which I am now treating, that all the invisible mechanism of dyeing consists in dilating the pores of the body to be dyed, in depositing in them particles of foreign matters, and retaining them there by a kind of covering not liable to be effected by water, rain, or the rays of the sun; in choosing colouring particles of such a degree of fineness as to be rendered sufficiently fixed in the pores of the stuff opened by the heat of boiling water, and again constricted by cold, and also coated by the kind of varnish which the salts employed in its preparation had left in those pores; whence it follows, that the pores of the fibres of the wool which has been wrought, or is to be wrought into cloth, should be cleansed, enlarged, coated over, and then constricted, so that the colouring particles may be retained in the pores nearly in the same manner as the diamond is retained in the collet of a ring." Notwithstanding the erroneous views of Hellot, the inferences which he deduced from them were not destitute of practical utility, and many of the processes which he recommended may be followed with the same advantage as if they had been derived from more scientific principles. Nor shall we wonder at this, if we reflect that the most correct theory seldom does more than illustrate the nature of the practical operation which experience has previously discovered to be useful.

Opinions of Hel lot.

Opinions of Macquer.

27. The theoretical opinions of Hellot were adopted by the celebrated Macquer, whom the French government had appointed his successor for superintending the practice of dyeing; and cultivating such branches of science as had a tendency to promote the improvement of the art. In a memoir which is printed among those of the Royal Academy of Sciences for 1749, he not only admits the justness of Hellot's views; but expresses a high admiration of the ingenuity of his theory. "Ce savant chimiste est le premier qui ait porté le flameau de la physique dans l'art obscure de la teinture, et qui ait rassemblé et mis en ordre, suivant les principes d'une théorie ingenieu se, les phénomènes et les opérations bizarres de cet art: il a mis les chimistes à porté de voir, clair dans ce chaos ténèbres. Macquer seems to have held the same sentiments concerning this very absurd hypothesis, so lately as the year 1766; for, in the eulogy pronounced by him on Hellot, and inserted in the Memoirs of the Academy for that year, he expresses himself thus strongly, a l'aide de cette théorie si lumineuse, on ne sera plus trompé dans la pratique de cet art, que lors qu'on vendra bien l'être. Some allowance, indeed, must be made for that studied determination to praise, which characterizes too many of these eulogies.

28. The labours of Macquer, however, contributed greatly to improve and extend the practical operations of dyeing, particularly of dyeing silk, to which he devoted much of his attention. He was the first who ascertained the real nature of Prussian blue, and he endeavoured to make an application of his discovery to the purposes of dyeing. He intended to have published a complete dissertation on the art, and in 1781 actually drew up a prospectus of the work; but a continued state of bad health prevented him from prosecuting his design, and he died in 1784 without having accomplished his intentions. Before his death, he abandoned the hypothetical opinions of Hellot, and embraced the more rational theory of the processes of dyeing which, before that event, had been suggested by Keir, and demonstrated by Bergman and Berthollet.

29. Mr Keir, the ingenious translator of Macquer's Chemical Dictionary, appears, according to Mr Henry, to have been the first who proposed a true explanation of the cause of the adhesion of the colouring matters to stuffs. He suspected that when the aluminous mordant was employed, the earth of alum was precipitated, and in this state became attached to the cloth; an opinion which, as we have already hinted, was latterly adopted by Macquer himself, and enforced at the article Teinture of his Dictionnaire de Chimie. Berthollet, on the other hand, ascribes the true theory of mordants, by whom first suggested.

Opinions of Bergman.

Opinions of Macquer.

20. We are indebted to Bergman, however, and more

Benefits which he conferred upon dyeing.

True theory of mordants, by whom first suggested.
particularly to Berthollet, for the complete demonstration of the truth of these opinions. The latter of these celebrated chemists succeeded Macquer in the place of trust which he held in France under the commercial department of administration, and by conjoining extensive observation with enlightened theory, has done more than any of his predecessors to promote the improvement of dyeing, and to raise it from an obscure empirical art, to the rank of a branch of chemical science. Since his appointment to the superintendence of the arts connected with chemistry, almost all the investigations which he has inserted in the 

**Memoirs of the Academy, in the Journal de Physique, and the Annales de Chimie,** relate more or less to the elucidation of the arts. In 1791, he published his *Elements of the Art of Dyeing,* in 2 vols. 8vo, a second edition of which, with considerable improvements, appeared in 1803. This treatise may be regarded as a standard work on dyeing, since it contains not only a detailed account of the practical operations of the art, but a theoretical view of the principles upon which they are founded. The subject of dyeing has also attracted the attention of Chaptal, who held, for a considerable time, the office of minister of the interior, under the French government. This excellent chemist, in his work entitled, *Chymie appliquée aux arts,* has introduced many original observations on dyeing, and described the leading processes of the art with much philosophical elegance. He investigated, with great care, the nature of Adrianople red, and published the result of his experiments and observations on that celebrated colour, in the 26th vol. of the *Annales de Chimie.* Several other chemists in France have written dissertations on dyeing, which deserve to be noticed in this place. Among these we may mention a small but useful work by M. Vitalis de Rouen, entitled *Manuel de Teinturier sur fil et sur coton filé,* a French translation of Scheffer, which first appeared in 1748, and was reprinted with notes by Bergman; another of Penner from the German; and an original work by Dambournay. The treatise of Scheffer was chiefly intended for the benefit of Swedish dyers; that of Penner contains an account of many experiments made by the author to ascertain the qualities of different dyes, but these seem to have been guided by no scientific views; and the work of Dambournay is still more defective in that respect.

31. Any improvements in dyeing, which have been made in Britain, must be ascribed entirely to the exertions of private individuals, unaided by the patronage of government. In France the case was different; the legislature of that country, as we have already stated, not only appointed proper persons to superintend officially the practice of dyeing in all its departments, but held out suitable rewards for the encouragement of such individuals as should contribute by their discoveries to the progress of the art. The beneficial effects of this liberal and enlightened policy were quickly felt in the numerous improvements in dyeing, which were suggested from time to time by the eminent men who filled these official situations; and it is certainly matter of regret, that no appointment of the same kind has ever been proposed in our own country, where so much importance is attached to arts and manufactures. We are supported by the authority of Mr Anderson* and Mr Home,† in maintaining that the superior brilliancy of colour, which distinguishes several articles of French manufacture above those of other nations, is greatly owing to this fostering care of government.

32. But though the British government has hitherto neglected to encourage an art, upon the proper cultivation of which so much of the success of our commercial competition with other nations must depend, a few of our countrymen have devoted their attention to dyeing, and furnished, at their own expense, the most valuable information to the public. Mr Henry of Manchester directed his attention to the subject at a very early period, and published an interesting paper, (which is inserted in the 8th volume of the *Memoirs of the Manchester Society,* "on the nature of wool, silk, and cotton, as objects of the art of dyeing; on the various preparations and mordants requisite for these different substances; and on the nature and properties of colouring matter," &c. This paper is drawn up with the author's usual philosophical precision, and contains many ingenious views, and much useful information. His observations respecting the cause of the durability of Adrianople red, display an intimate acquaintance with the subject, and do great credit to his talents and information. We are indebted to Mr Henry for the first account of the nature of the aluminous mordant. He shewed, that when the acetate of lead was presented to the sulphate of alumine, a double decomposition took place: that the acetic acid quitted the lead, and combined with the alumine, while the sulphuric acid united with the lead, thus forming two new salts, the acetate of alumine, and the sulphate of lead.

33. No original treatise on dyeing, however, appeared in our language, till Dr Bancroft published his excellent work, entitled, "Experimental Researches concerning the Philosophy of Permanent Colours." The first volume of this work appeared in 1794; and the second, which had been long expected with much anxiety, so lately as 1813. The author has furnished the world with the results of an immense number of experiments, prosecuted with unremitting care during a long course of years, and at a great expense. Though he has been preceded by authors of such distinguished ability, as Mr Henry and Mr Berthollet, the new facts and observations which he offers to his readers shew, to use his own words, that he did not find the subject exhausted. His views are often entirely original; and he has detected a considerable number of mistakes into which Berthollet and others had fallen. He has investigated with much ability the action of tartar in the dyeing of scarlet, and proved by the most decisive experiments, that, with cochineal, the salts of tin produced only a crimson, contrary to the statements of that able chemist, who had entirely misrepresented the operation of these substances in the production of the former of these colours. He has ascertained, that scarlet is a compound colour, formed by the superinduction of a crimson upon yellow; and, in consequence of this discovery, he has proposed a method of dyeing this colour more cheaply, more expeditiously, and more durably than by the ordinary process. But the most important service which Dr Bancroft has rendered to the art of dyeing was, the introduction of quercitron as a yellow colouring matter, the use and application of which for dyeing, calico-printing, &c., were exclusively vested in him for a term of years, by an act of parliament passed in the 25th year of his present Majesty's reign. After the term of the act expired, an unsuccessful attempt was made to obtain a renewal of it, on the grounds that the Doctor had exercised his right more beneficially and liberally for the public, than providently towards himself and family; and that
he had also been deprived of a great part of his just profits by various infringements of the act. A bill for that purpose was accordingly passed in the House of Commons, in the 59th of his present Majesty; but it was lost in the House of Lords, in consequence of the strong opposition which it encountered from a great number of persons in the northern part of the kingdom, some of whom had grown rich by the discovery. It does not appear that the public derived much advantage from this alienation of the Doctor’s right, as the bar of question soon rose to three times the price at which he had invariably supplied it, and would have been bound to supply it, for another term of seven years, if the bill had passed in his favour. The policy of sanctioning a monopoly expressly by law may be justly questioned; but every candid and liberal mind will readily admit, that, considering the very important improvements in dyeing which Dr Bancroft has introduced, the long and severe labour to which he has submitted, and the great expense which he has incurred in the prosecution of his inquiries, he is entitled to some higher remuneration for his services, than the country has yet thought proper to bestow.

34. "Of all the arts," says Berthollet, "that of dyeing, perhaps, with respect to its theory, requires the most extensive knowledge of natural philosophy; because it is that which presents the greatest number of phenomena to analyze, of uncertain changes to ascertain, and of relations to establish with air, light, heat, and many other agents, of which our knowledge hitherto has been very imperfect." But these remarks, though certainly well-founded, ought not to discourage. If many facts remain still to be explained, science has already done much in determining the essential circumstances of particular processes, and excluding such as are either absurd or superfluous; in analyzing the substances employed by the dyer, and discovering the causes to which their action is to be ascribed; and lastly, in suggesting the means most likely to improve the art.

35. In the following account which we propose to give of the operations of dyeing, our object is not so much to bring forward a new treatise, as to collect and condense every thing useful that has already been written on the subject; and to present a view of the art, which shall include the most recent improvements, without neglecting the description of those processes which have long received the sanction of experience. In the execution of this plan, we shall freely avail ourselves of the labours of the most approved writers on dyeing, particularly of Berthollet and Bancroft, as well as of the different individuals who may have suggested improvements in particular processes. In short, we shall aim at usefulness rather than novelty, and never introduce theoretical views, unless they have an obvious tendency to simplify or improve practical operations. When facts occur which we cannot explain, we must be satisfied with detailing the process of the art, and wait for further light from experience, before we attempt to reduce them to theory.

SECTION II.

OF COLOURING MATTERS.

CHAP. I.

OF COLOURING MATTERS IN GENERAL.

36 The knowledge of the laws according to which bodies appear of various colours, by absorbing some of the rays of light, and reflecting others, is of very little use to the practical dyer. His object is merely to extract the colouring principle from the substances which form its original basis; to transfer it to the stuff; to modify it by those agents which have been found by previous experiment to affect its nature; and to give it permanency in its new state of combination. Still, however, it may not be altogether foreign to our purpose to take a slight view of the theoretical opinions which are entertained on this subject.

37. The property which bodies possess of uniformly reflecting certain rays of light, constitutes their colour; for all the rays are absorbed, a body appears totally destitute of colour, or black; and when particular rays are absorbed, and others reflected, it seems to be of the colour which the reflected ray is capable of exciting in our organs of vision. When the substances which thus appear coloured are transferred to colourless bodies, they generally communicate to these bodies their particular colour; and when they are transferred to bodies already coloured, they blend or mingle their colour with that of the substance by which they are applied, and give rise to mixed colours.

38. The aptitude of reflecting particular rays of light, seems to depend not so much upon the chemical composition of a body, as upon a certain arrangement, or disposition of the particles of the surface. Many bodies display different colours, according to the particular angle under which they are viewed; while others assume a change of colour, simply by the change of their mechanical condition.

39. Hence it appears that colour ought not to be regarded as a distinct principle, existing separately from the coloured body; but merely as a faculty which the constituent elements of bodies possess of reflecting particular rays of light decomposed at their surface, and which is capable of being modified by changes in the mechanical structure, or in the proportion of the elementary parts. It is therefore impossible to predict, a priori, the colour of a compound body, from a knowledge of the principles of which it is composed. Frequently two colourless bodies form a coloured compound by mixture; and it often happens that two substances, each of which has a very deep colour, are rendered entirely colourless when they are united together. In short, we can only determine by observation and experiment, the colours which shall result from particular combinations of bodies.

40. These views, however, do not altogether accord with the opinions of several eminent chemists, particularly with respect to colours of vegetable origin. Many seem to think that a peculiar proximate principle exists in vegetables, in which their colour generally resides, and to which they owe the name of colouring matter. "In this opinion," as Mr Murray justly observes, "there is a degree of obscurity and vagueness." Colour being, as we have already stated, a secondary quality, which may reside in any principle, and being often exhibited by principles of the most opposite kind, there is no good reason for supposing that there is any distinct principle to which it exclusively belongs. At the same time, it must be admitted that there is apparently a similarity in chemical constitution between certain vegetable products, in which colouring matters reside in the deepest intensity; and that these colouring matters may be detached from their state of combination by the agency of various solvents, and transferred to other substances with which
they appear to have a more powerful affinity, and this
too without our being able to refer the appearances
which take place to any known proximate princi-
ple.

41. These facts, however, by no means authorise
us to conclude that the colouring matter is a separate
and independent principle; all that can be inferred
from them is, that the colouring matter does not uni-
formly exist in combination with any particular proxi-
mate principle, but probably with different proximate
principles, or various combinations of them; though
the present state of chemical analysis does not enable
us to ascertain the composition of the colouring par-
ticles with a degree of precision sufficient to detect the
principles to which they owe their properties. Without
taking any notice, therefore, of the theories which have
been advanced to explain the cause of colour, we shall
be satisfied with presenting a general view of the dif-
ferent colouring matters, and leave to future investiga-
tion the task of discovering whether these colouring
matters form separate substances, or exist uniformly in
combination with some particular proximate principle
as a basis.

42. It has been proposed to divide the colouring
particles of vegetables into extractive and resinous;
but this division is attended with no advantage, and
indeed only serves to convey very imperfect and erro-
neous ideas of their properties, as some of the most im-
portant dyes are not at all affected by the usual solvents
which act upon these two classes of substances. The
truth is, that the colouring particles possess chemical
properties which are peculiar to themselves, and dis-
tinguish them from all other substances; though these
properties are different in different colouring matters.
They unite with acids, alkalies, metallic oxides, and some
of the earthy bodies, particularly alumine. They are
said to precipitate oxides and alumine from the acids
which hold them in combination; but this is doubtful,
or at least the decomposition is very partial. They
more frequently form triple compounds with the salts,
and in this state of combination unite with the stuffs
to which they are presented, in a more intimate man-
ner than they would do without the intervention of
these bodies.

43. The colouring particles do not, however, unite
indiscriminately with these chemical agents, and there-
fore require different solvents suited to their respective
qualities. The most common solvents are water, acids,
and alkalies; alcohol is seldom used, unless when we
wish to act on the colouring matter of very small bod-
ies. Of these substances, water is most extensively
employed, both on account of its abundance, and the
great solving power which it exerts over almost all
colouring matters; alkalies are employed to promote
the solution of the colouring principle contained in indi-
igo, the flowers of bastard saffron, &c.; and the acids
are used in some cases to dissolve colours, and in others
to precipitate the colouring principles from their solu-
tions in alkalies.

44. Before colouring principles are exposed to the
action of a solvent, they ought to be divided as minute-
ly as possible, by mechanical means. This is obtained
by triturating them in a mortar, or by means of a
muller, and afterwards passing them, in a reduced
state, through a fine sieve, that no gross particles may
escape notice. The methods by which the division
of colouring substances is produced, vary according to
the consistence, structure, and volatility of the mat-
ters upon which the operation is performed. In some
cases, the substance containing the colouring principle
is reduced to chips or scales, by means of a sharp in-
strument; in others, it is perfectly sufficient to bruise
it under mullers, in the same manner as tar is ground.
In whatever way pulverization is performed, the op-
eration is attended with the diffusion of a subtle pow-
der through the workshop, which is both injurious to
respiration, and the cause of a considerable loss to the
manufacturer, particularly if the article be expensive.
These disadvantages may be guarded against, by per-
forming the process of trituration in covered places, or
moistening the matters acted upon with water. After
the colouring principle is sufficiently comminuted, it
may be dissolved, without difficulty, in some of the sol-
vents formerly mentioned.

45. With the exception of some colouring matters of
Water, a resinosor or starchy nature, water may be regarded
as a universal solvent of that class of bodies; while it
possesses the important property of forming a very
imperfect union with them, and readily parts with
them again to the stuff. Warm water extracts the col-
ouring principle more copiously than cold water; but
different substances require different degrees of tempe-
rature for that purpose. Some colouring principles
may be dissolved by long protracted maceration;
others require a very gentle heat, and suffer in their
brilliancy by being exposed to too elevated a tempera-
ture; and others still yield but little of their colour,
unless they be raised to a considerable degree of heat.
A knowledge of these circumstances is absolutely ne-
necessary to the dyer, in order that he may conduct his
operations with certainty and success.

46. A great deal has been ascribed to the qualities of
waters used in dyeing, nothing being more common
than to refer the brilliancy of some colours, and the po-
verty of others, entirely to this cause. Without adopt-
ing implicitly all that has been published on this sub-
ject, it must be allowed that waters contribute essen-
tially to the qualities of dyes; and it may be added, that
different colours, and even the same colour in different
states, require that waters of very different natures
should be employed. Rapid and running waters are
generally the purest, and standing waters most impreg-
nated with earthy and saline matters. In some cases,
however, the latter may be used with great advantage
in dyeing; because the putrid animal and vegetable
matters suspended in them, contribute to form ammonia
and sulphureted hydrogen, which precipitate the earthy
and metallic principles.

47. Waters holding calcareous salts in solution, are
particularly prejudicial to the dyeing cotton of a red col-
our. The lime which is precipitated during the pro-
cess attaches itself to the stuff, and obscures the colour
to such a degree that it is almost impossible to revive it.
But if the object be to obtain a dark colour, these salts
are rather beneficial than hurtful, as they tend to in-
crease the body of the red colour and its modifications,
hence they may be used with advantage when it is in-
tended to convert scarlet into crimson.

48. Calcareous salts dissolved in water, not only af-
fact the brilliancy of some colours, but possess the in-
convenience of weakening the solvent which holds them
in solution, and thus extract imperfectly the colouring
principle. It is of consequence, therefore, to be able
to detect the presence of these salts, that we may either
avoid the water which contains them, or correct its pre-
judicial qualities. Chemistry furnishes us with the
means not only of discovering the different ingredients
which exist in water, but of ascertaining with precision
the quantity of each. The salts of lime, the most common earth which is to be found in water, are easily detected by the copious white precipitate which they afford with the oxalate of ammonia, and those of iron by a solution of galls. In general, water which contains earthy or metallic salts, in such quantity as to be injurious, readily decomposes soap by a double affinity: the acid combines with the alkali of the soap, while the earthy basis unites with the oil, and forming an earthy soap which is insoluble, produces the curdling appearance observable on such occasions. If then a water be clear, destitute of taste and smell, and capable of dissolving soap readily, it may be regarded proper for the objects of dyeing; and all waters which possess these properties are equally fit for the purpose. But it may be remarked, that waters which hold the earths mechanically suspended, that is, such as are muddy, are less prejudicial than those which hold them in solution: In the first case, they attach themselves but loosely to the stuff; in the second, they are precipitated in a state of minute division, and combining with the mordant, become intimately united with the cloth.

49. But as it is not always in our power to choose water of the best quality, means have been devised for correcting the injurious properties of this fluid, when it happens to be bad. The most common corrective for this purpose is bran, which is allowed to remain in the water until it acquires a sour taste. Twenty-four bushels of bran are put into a tub or vat that will contain about 10 hogsheads; a large boiler is filled with water, which, when just ready to boil, is poured into the vat: the acid fermentation soon commences, and in 24 hours the liquor is ready for use. Berthollet conceives that the sour water acts by decomposing the carbonate of lime and magnesia, from which its acid, being more powerful, disengages the carbonic acid; and that in this way the earthy sediment, which is occasioned by boiling, is prevented from taking place.

Alkalis.

50. Alkali, the next solvent in order which we mentioned, is employed to dissolve several colours. In general, as Captain remarks, the colours which are produced by fermentation are less soluble in water than alkali. This is the case with indigo, wood, &c. Thus, boiling water dissolves only a ninth-part of its weight of indigo; wood communicates very little colour to this fluid; and annotta can scarcely be dissolved in it at all without the aid of alkali. After the colouring matter has been extracted by an alkali, it is precipitated by the addition of some weak acid.

Acids.

51. Acids are sometimes employed as solvents of colouring principles. The chemical blue of Pernier, or the Saxon blue of dyers, is a solution of indigo in concentrated sulphuric acid. Guhllic has proposed to extract the colour of yellow wood, broom, turmeric, &c. by means of the aceto-citric, and simple acetic acid, or nitric ether and vegetable acids. The nitric and oxy-muriatic acids impart a yellow tinge to all animal substances; and the former of these acids is even successfully employed to communicate to silk and wool a very beautiful yellow colour. The nitric acid produces a similar effect on madder; but the yellow thus developed disappears when the acid is neutralized.

Primary colours.

52. The simple colours, or at least those obtained from the decomposition of light by means of the prism, are seven in number, viz. red, orange, yellow, green, blue, indigo, and violet. These colours are supposed to be homogeneous or simple, because when they are transmitted a second time through the prism, they are refracted without undergoing any further change. This argument, however, is by no means conclusive; for if any coloured ray be composed of two others, each of these must have the same refrangibility, as it is in consequence of this circumstance alone that they could occupy the same place in the prismatic spectrum; and, in that case, a second refraction could not separate them. The truth is, that the prism furnishes only one means of the analysis of light, and merely shows that certain rays differ from others in refrangibility.

53. Before the discoveries of Newton, the red, yellow, and blue, were generally supposed to be primary rays, and the rest to be compound colours arising from their intermixture. Thus, red with yellow, produced orange; yellow with blue, green; and blue with red, indigo. Another hypothesis has been lately advanced by Prieur; and supported by very ingenious reasoning. According to him, the red, green, and violet, are the primary rays; the red and green giving rise, by their intermixture, to orange or yellow, according as the former or the latter predominates; the green and violet forming blue; and the violet and red purple; and thus, by various modifications of the three original colours, all the others are obtained. We shall give an example of the kind of proof which has been adduced in support of this hypothesis. Let one of the rays, as orange, be selected—a colour which is supposed to be a compound of red and green, the former being in excess. If this colour be really a compound of red and green, and if the arrival of the rays to the part of the spectrum which the orange usually occupies be prevented, by the interposition of a substance that allows only the red or the green rays to pass, we ought to find beyond this substance only red or green; on the other hand, if the orange be simple, these rays will pass through neither of the interposed substances, and beyond this we should have only black. The results corresponded with the hypothesis in a great variety of trials. An additional argument was also derived for its support, by combining the red, green, and blue rays, and thus obtaining white light.

54. In a practical point of view, such opinions are of very little moment; and perhaps it may be more useful to attend to those distinctive characters of the colouring principles, which are founded on their chemical relations with the stuffs. Accordingly, Dr Bancroft has suggested the division of colouring matters into substantive and adjutive colouring matters; "the first including those matters which, when put into a state of solution, may be fixed with all the permanency of which they are susceptible, and made fully to exhibit their colours in or upon the dyed substance, without the interposition of any earthly or metallic basis; and the second comprehending all those matters which are incapable of being so fixed, and made to display their proper colours without the mediation of some such basis." (Philosophy of Permanent Colours, vol. i. p. 118.) These terms, though perhaps not altogether unexcepcionable, must at least be admitted to have a reference to real differences between the substances which they are intended to distinguish; and though the advantages which are derived from this arrangement are small but slight, since very few colouring matters are contained under the first head, but most of them under the second, there can be no impropriety in adopting them, particularly as they are intended to express a fact, and not a theoretical opinion. In treating of colouring matters, we shall therefore observe Dr Bancroft's distribution of them; but in describing the processes by
which these are applied to the stuffs, we conceive it will be more convenient, and not less systematic, to follow same arrangement which has a reference to the colours themselves, rather than to the colouring matters from which they are procured. We shall accordingly divide the colours, without any regard to the decompositions obtained by the prism, into simple and compound; meaning by the latter, such as can, and by the former, such as cannot, be produced by the intermixture of other colours. Under simple colours, we shall include red, yellow, and blue; and under compound colours, the various modifications of these which are obtained by mixture or superinduction.

CHAP. II.

Of Substantive Colouring Matters.

I. Of Animal Substantive Colouring Matters.

55. Dr Bancroft has subdivided this class of colouring matters into animal, vegetable, and mineral. The principal dye belonging to the first kind of arrangement, is the celebrated Tyrian purple. The substance which yielded that beautiful colour, was a whitish half-fluid matter, secreted by particular organs in certain univalvular shellfish, and retained by the animal in an appropriate receptacle. The accounts which have been transmitted to us by the ancients respecting the shell-fish in question, are obscure and contradictory. Those of Pliny are the most explicit and intelligible, though they are sometimes inconsistent with each other. He mentions the shell-fish which afforded this dye, under the several names of conchylia, murex, purpura, and buccinum; all of which are also used by other Roman writers. This curious subject has been so ably investigated by Dr Bancroft, that very little further elucidation can be thrown upon it; we shall therefore avail ourselves of his researches, and communicate the substance of them as fully as is consistent with the nature of our work.

56. It appears that Fabius Columna, a Neapolitan nobleman, was the earliest modern writer who wrote a dissertation on the Purpura, which he published in 1616. After being at much pains to elucidate and reconcile the different passages of ancient writers on this subject, he came to the conclusion that there were two kinds or genera of shell-fish used for procuring the purple dye, viz. the purpura and buccinum; that the term conchylia signified generally all the species of purpura, and sometimes the purple colour itself; and that the term murex was also used in the same generic sense. Pliny, indeed, expressly mentions, that all the shell-fish yielding the purple and other lighter colours of the conchylia, are in matter the same, and differ only in temperament; that they are of two kinds, one being called buccinum, from its resemblance to the instrument called the horn, and the other purpura. The former he describes as being round at the aperture, and having a serrated margin; the latter as having a projecting pipeshaped beak, with a lateral winding cavity, through which it puts forth its tongue. He mentions also that the body of the shell of the purpura is muricated or armed with seven rows of spires, which are wanting in the buccinum. He adds, that the buccinum adheres to rocks and large stones, whence alone it can be collected.

57. The best purpura found on the coasts of Asia were caught in the sea adjoining to Tyre; on the African coast, the best were those of Meninx and the Ge-tulian shores; and the best on the coasts of Europe were found at Laconica. Pliny informs us, that the Tyrians took the finest out of the larger shells, in order to extract the purple more effectually, but obtained the colour from the smaller by grinding them in mills. He adds, that when the purpura were caught, the receptacle which contained the dyeing liquor was taken out and laid in salt for three days; and that after a sufficiency of the matter had been collected, it was boiled slowly in leaden vessels over a gentle fire, the workmen skimming off from time to time the fleshy impurities. This process lasted ten days, after which the liquor was tried by dipping wool into it, and if the colour produced by it was defective, the boiling was renewed. Pliny afterwards erroneously represents the liquor of the buccinum as only yielding a fugitive colour, and says that it was usually mixed with more than half as much of the liquor of the purpura, which of itself gave a very dark purple; and that the mixture produced a beautiful amethyst colour, the latter giving permanency to the former, and being in return brightened and enlivened by it. We rely on the same authority, that the Tyrians produced their purple by first dyeing the wool with the unprepared or greenish liquor of the purpura, (another name which he applies to the purpura,) and afterwards in the liquor of the buccinum, and that the resulting colour was deemed most perfect when it resembled that of coagulated blood.

58. It is farther stated by Pliny, that it not being thought sufficient to communicate the colour of the amethyst to wool, it became customary to dye it again with the Tyrian purple; and that in reference to this circumstance, the compound colour produced by this refinement in luxury, was called Tyrriamethystus. He adds, that, not content with thus combining colours obtained from the ocean, recourse was also had to those produced on the land; and that wool or cloth dyed crimson from the coccus (kermes) was afterwards made to imitate the Tyrian purple, in order that it might assume the colour which was named hysginus, after a flower so called. Other colouring matters were employed, sometimes to economize, and at other times vary the effects of the colours of the purpura and buccinum. Among these, Pliny enumerates fucus mari- nus or anchil, and the anchusa tinctoria or alkanet, both of which are still used as dyes. By these and other means, the purple colour was made to assume a variety of shades, some inclining more to the blue, and others more to the crimson.

59. Under the history of dyeing, we took notice of the restrictions which had been imposed upon the use of the Tyrian purple, and mentioned other circumstances which gradually led to the total neglect of that celebrated dye; we shall now describe a little more minutely the methods of communicating that colour, by means of shell-fish, which have been employed in modern times. In the year 1683, Mr William Cole of Bristol being at Minehead, he was there told of a person living at a sea port in Ireland, who had made considerable gain by marking with a delicate durable crimson colour, the fine linens of ladies and gentlemen sent to him for that purpose, and that this colour was made by some liquid substance taken out of shell fish. Mr Cole, being a lover of natural history, and having his curiosity thus excited, went in quest of these shell fish; and after trying various kinds without success, he at length found considerable quantities of a species of buccinum on the sea coasts of Somersetshire, and the opposite coasts of South Wales. After many ineffectual endeavours, he...
discovered the colouring matter placed in a "white
vein lying transversely in a little furrow or cleft next
to the head of the fish, which," says he, "must be dig-
ged out with the stiff point of a horse hair pencil, made
short and tapering, by reason of the viscous clamminess
of the white liquor in the vein, that by its stiffness
it may drive in the matter into the fine linen or white
silk" intended to be marked. Letters or marks made
in this way, with the white liquor in question, "will
presently," adds he, "appear of a pleasant green colour,
and if placed in the sun, will change into the following
colours, i.e. if in the winter, about noon, if in the sum-
mer, an hour or two after sunrise, and so much before
setting, (for in the heat of the day in summer, the col-
ours will come on so fast that the succession of each
colour will scarce be distinguishable;) next to the first
light green will appear a deep green, and in a few
minutes this will change into a full sea-green, after which
in a few minutes more, it will alter into a watery blue.
and from that, in a little time more, it will be of a par-
nish red, after which, lying an hour or two, (supposing
through this sun's shining,) it will be of a very deep
purple red, beyond which the sun can do no more." He re-
marks, however, that "these changes are made faster or
slower, according to the degree of the sun's heat;" "but
then," adds he, "the last and most beautiful colour, af-
fter washing in scalding water and soap, will (the mat-
ter being again exposed to the sun or wind to dry) be
much a differing colour from all those mentioned, i.e.
a fair bright crimson, or near to the Prince's colour,
which, afterwards, notwithstanding there is no styptic
to bind the colour, will continue the same, if well or-
dered, as I have found in handkerchiefs that have been
washed more than forty times, only it will be some-
what alloyed from what it was after the first washing."

60. M. Cole sent some of the linen marked in this
way to Dr Plot, then one of the secretaries of the
Royal Society, in November 1684; which was soon af-
ter shewn to Charles the Second, who admired it great-
ly, and desired that some of the liquor might be sent
to town, in order that he might witness its effects. But
before this could be done, the king died, and it ap-
tains that little further interest was at that time excited
about the matter. After an interval of twenty-four
years, M. Jussieu found a small species of buccinum
on the western shores of France, and presented some
of them to him in 1789 to the Royal Academy of Sciences at
Paris; and in the following year, Reaumur discovered
great numbers of the same shell-fish on the coast of
Poitou. Reaumur observed, that the stones and little
sandy ridges round which they had collected, were
covered with a kind of oval "graines," some of which
were white, and others of a yellowish colour; and hav-
ing squeezed some of them upon the sleeve of his shir-
t, he was agreeably surprised, in about half an hour,
to find it stained of a fine purple colour, which he
was unable to discharge by washing. He next collect-
ed a quantity of these grains, and carrying them to
his apartment, bruised and squeezed different parcels
of them upon bits of linen; but, to his great surprise,
after waiting two or three hours, no colour appeared
upon the spots wetted with the liquor. Unable to con-
template the reason of this disappointment, and having
almost determined to return again to the sea-shore, and
repeat the experiment on the same plan as before, he
chanced to perceive some purple spots, occasioned by
drops of the liquor which had accidentally fallen upon
a part of the plaster of Paris with which the sides of
the window were covered, and which having been more
strongly acted upon by the light than the bits of linen
wetted with the same liquor in the interior part of the
room, had become purple, though the day was then
cloudy. He afterwards made a variety of experiments
with the liquor of the buccinum; but as he was, from
the outset, impressed with the notion that the conver-
sion of it to purple was occasioned by some mechanical
action of the air, he never discovered the true cause
of the production of that colour.

61. Reaumur conceived the grains in question to be
the eggs or spawn of some fish, but whether of the bucci-
um or any other species, he was uncertain, and under
this uncertainty he proposed calling them œufs de pour-
pre, eggs of purple. The colour which they produced
was at least equal, if not superior, in beauty, as well as
durability, to that of the buccinum; though the colour-
ing matter of the latter was much thicker, and passed
less quickly through the different shades of colour, on
exposure to the light of the sun. He also found that
the liquor of the buccinum tasted as hot as the hottest
pepper, whilst that of the purple eggs was pleasant. But
when the latter was so viscous, that, when topically ap-
plied to linen, it did not run; and as the grains were,
according to his accounts, so plentiful, that one man
might collect half a bushel of them in a few hours,
there is certainly reason to conclude, says Dr Bancroft,
that they would be highly useful, at least in calico-
printing, where their liquor might be applied with the
greatest facility, both for pencilling and printing, as a
substantive topical colour, and where a small quantity
would go far, especially upon fine muslins.

62. About the beginning of the year 1736, Duhamel
discovered the purpura in great abundance upon the
cost of Provence. He found the viscid colouring mat-
ter of the fish to be white, except in a few instances in
which it was green, an appearance which he ascribed
to disease. The white liquor being exposed to the sun's
rays, assumed the following colours: 1. A pale yellowish
green; 2. An emerald green; 3. A dark blueish green;
4. A blue with a tinge of red; 5. A purple; and these
changes all happened in less than five minutes. In all
the experiments which were made with the purpura,
the presence of light was found essential to the for-
mation of the purple colour; and the effect was produced
most expeditiously when the influence of the sun's rays
was most powerful.

63. Little doubt can now be entertained of the identity
of the shell fish employed by the ancients, and those
discovered by Cole, Reaumur, and Duhamel. Both Ari-
stotle and Pliny have informed us, that the liquor of
the purpura was white; and the latter also remarks, that
the purple colour which it afforded was not instantane-
ously produced, but after a succession of several col-
ours, of which green was one. We have also a de-
scription of the manner of catching the shell fish, em-
ployed for the purple dye, written by an eye witness,
Eudocia Macrembolitissa, daughter of the emperor
Constantine the Eighth, who lived in the eleventh
century, while the knowledge of dyeing the Tyrian purple
still remained; and from which it appears, that the
ancient purple did not acquire its due lustre and per-
fecion until it had been exposed to the sun's rays.

64. Berthollet is inclined to believe, that the changes,
cause of the change of colour of the purpura and buccinum
under the sun, go by exposure to the sun's rays, are owing to
the

* Color austerus in Glauco, et irascensce similis mari. Lib. ix. cap. 36.
Dyeing.

II. Of Vegetable Substantive Colours.

60. The substantive colours obtained from vegetables are more numerous than those which are of animal origin, and far more interesting to the dyer. Of these, the most singular, as well as the most important, is indigo, a blue colouring substance extracted from a genius of plants known by the name of indigofera and indigo, which are cultivated for its production in America and the West Indies. Indigo consists of a peculiar colouring matter, which may be denominated its basis, and which being combined with a certain portion of oxygen, is, during its union, insoluble by any means unless such as exert an agency more or less destructive on the basis itself. This basis is, in its uncombined state, entirely destitute of colour; and seems to be formed by certain peculiar secretory organs, possessed by a few particular plants. Dr Bancroft states, that the expressed juice of the leaves of the indigo plant communicates to calico a greenish tinge, which in dyeing approaches to blue, and ultimately assumes that colour; and that repeated applications of it to the same spot, increase the deepness of the shade, and at last produce a full blue. He suspects, however, that the colouring matter of the indigo, when thus applied in its native state, does not absorb so much oxygen, as when it undergoes the fermentive process by which it is usually prepared for the purposes of dyeing.

61. In another part of this work, (see Indigo,) General Bancroft shall describe the various processes which are properties employed for preparing indigo, and confine ourselves at present to a description of its nature and properties as a dye. In its prepared state, indigo is of a very rich blue colour, which varies, however, in its shade, in different specimens. This difference seems to be owing not so much to any real difference of quality in the colouring matter, as to the foreign substances with which it is occasionally united. When indigo is pure, it is light and friable; tasteless, and almost destitute of smell; and having a smooth fracture. Some varieties are lighter than water; and the lightest is generally, the purest. Indigo is frequently adulterated by adding to it gummy, resinous, and earthy substances, particularly an extract from the fruit of the embryop- teris glutinifera, denominated gaub in the East Indies. Both its weight and its purity are affected by the presence of lime, which having been used in excess, as a precipitate, had subsided with the colouring matter, and carried down other impurities along with it.

62. The finest and most valuable indigo was formerly brought from Guatimala; but since the manufacture of this commodity engaged the attention of the British inhabitants in the East Indies, indigo superior even to that of Guatimala has been imported, in considerable quantity, from that quarter. Dr Bancroft enumerates three varieties of American indigo: of which the first, called by the Spaniards flora, has a very fine blue colour; the second, which bears the name of color satiente, is violet; and the third, named corti-color, is copper-colour-
ed. When the first of these, he adds, sells at 9s. a pound, the second is commonly thought to be worth 7s. and the third 5s. 6d. The finest blue indigo from the East Indies commonly sells 20 per cent. higher even than the finest glowing, (though the last probably contains nearly as much colouring matter as the first); and 70 or 80 per cent. higher than the best copper-coloured.

72. Berthollet has proposed a method of determining the relative values of different specimens of indigo, by dissolving equal portions of each in sulphuric acid, and afterwards destroying their colour by means of oxymuriatic acid; that specimen being considered as the most valuable which required the greatest quantity of oxymuriatic acid to destroy its colour. Dr Bancroft has suggested another method of ascertaining the same thing, which is more simple, and perhaps not less accurate. He proposes to mix equal portions of different solutions in sulphuric acid, and, after diluting these with a certain quantity of water, to compare the shades of colour possessed by the several mixtures.

73. According to the experiments of Bergman, one part in nine of indigo is soluble in water by boiling; and this part appeared to consist of mucilaginous, astringent, and saponaceous particles. The astringent particles are precipitated by solutions of alum, sulphate of iron, and sulphate of copper. M. Quatramore also has separated the soluble parts by means of water. He mentions, that their quantity is greater in proportion as the indigo is inferior in quality, and that the residue, after this operation, is equal to the finest indigo. He accordingly proposes to purify indigo of inferior quality by boiling it in a bag, renewing the water till it acquires no more colour. For the chemical properties and composition of indigo, see CHEMISTRY, vol. vi. p. 112.

Green indigo. 20.

74. About the year 1790, Mr Alderman Princep, who had then lately returned from India, presented Dr Bancroft with a specimen of indigo which he had procured in that country, and to which he gave the name of green indigo. Dr Bancroft at first entertained the hope of its proving the same kind of colouring matter, as that obtained by the inhabitants of Cochin-China from a plant called tan, which, when macerated and fermented like indigo, yields a green fecla capable of dyeing a beautiful and lasting emerald green. The specimen was too small, however, to enable Dr Bancroft to examine its properties with sufficient precision; but he ascertained, that it differed in several respects from common indigo, and particularly that it did not produce, like that substance, a fixed colour on linen or cotton by topical application. See Bancroft, i. 264.

Baraant verte. 20.

75. About three years afterwards, considerable attention was excited, among those who took an interest in the improvements of dyeing, to another species of indigo which had been sent from Calcutta, under the name of baraut verte. It was described to be a simple substance, and to have been prepared with water and fire only, "from an indigofeorous plant, an ever green, with leaves somewhat resembling those of the laurel, bearing large clusters of small yellow flowers, and producing seeds in large pods pointed at the end." and it was added, "that the seed did not vegetate in Bengal." It was also represented as giving a durable light green colour, without any mordant or basis, to silk and wool. Dr Bancroft soon procured a specimen of this colouring matter, and, with his usual zeal, set about an examination of its properties. After making a few experiments upon it, he discovered that it was a species of impure indigo, and that it owed its green colour to the presence of an olive-coloured matter, which, on being burnt, appeared to consist chiefly of carbon. The manufacture of this dye was therefore abandoned.

76. Pastel, or woad, also affords a blue colouring matter, which possesses properties somewhat analogous to those of indigo. Two species of plants are distinguished under this name, the isatis tinctoria, and the isatis Lusitanica. The former is chiefly cultivated in Languedoc, Provence, and Normandy; and also in some parts of England. The plant, after being cut down, is washed in a running stream, and then dried in the sun, as speedily as possible. When it is dried slowly, it is in danger of being spoiled by the colour becoming black. It is next carried to the mill to be ground, and reduced to a paste. In this state it is formed into heaps, which are covered to secure them from rain. At the end of a fortnight these heaps are opened, and beaten, to produce a thorough intermixture of the crust formed on the surface with the internal part. It is then made into round balls, and placed in a situation where it may be freed from the moisture which still adheres to it. The balls are afterwards heaped above one another, to undergo the process of fermentation, and evolve the blue colour yielded by the plant. As the process advances, the smell of ammonia is exhaled, and the balls are gradually reduced to a coarse powder; the state in which woad occurs in commerce.

77. Pastel affords, without the assistance of indigo, a blue colour of considerable permanency, but little lustre. As it yields a small quantity of colouring matter in comparison of indigo, and of inferior beauty, the use of woad, as a dye, is now almost totally abandoned. Astruc affirms, that pastel treated like indigo yields a colouring matter which greatly resembles indigo; and Chaptal states, that, from experiments which he made in 1795, with the view of adding some vegetables to the list of those which furnish blue colours, he discovered that goats rue, sawn foin, chick peas, and lucern, yielded a blue colour when treated like indigo, which he did not, however, succeed in precipitating. D'Ambourney also attempted to procure indigo from pastel. He succeeded by letting fresh leaves of pastel ferment in a certain quantity of water; taking out the leaves, and pouring solution of caustic alkali into the liquor, and afterwards filtering. The fecla which remained on the filter, he says, resembles Carolina indigo. Thirty-five pounds of fresh ripe pastel leaves yielded eight ounces of fecla.

78. Turmeric is enumerated by Dr Bancroft among the vegetable colouring matters which he calls substantive; though the little durability which it possesses, as a dye, scarcely entitles it to that epithet. Turmeric is the root of the curcuma, of which there are two species, the rotunda and the longa. The former is chiefly cultivated for the use of the dyer. Turmeric is of a very rich colour, and surpasses every other yellow colouring matter in beauty; but it has a very slight attraction either to stuffs, or the mordants which are usually employed to give fixity to colours. The root must be reduced to powder to be fit for use. It is sometimes employed to give the yellows made with weld a golden cast, and to communicate an orange tint to scarlet; but its effects soon disappear.

79. Mr Bayley, who, in 1795, was extensively engaged in dyeing silk handkerchiefs to imitate those of India, informed Dr Bancroft that the yellow spots were produced solely by a tincture of turmeric made by di-
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Dyeing six pounds of the powder of turmeric in a gallon of malt spirits, and afterwards by a press separating three quarts of a rich tincture, which cost about four shillings the quart. The tincture was applied topically, and without thickening, to the spots of the silk handkerchiefs, which in the dyeing had been reserved white by the usual means. Dr Baneroff found that a tincture of turmeric so obtained, and gummed, when applied topically to calico, produced a beautiful yellow, which, by washing with soap, became red; but being well rinsed, and exposed to the atmosphere, it recovered its former colour, and retained it after several washings. See Baneroff, vol. i. p. 278.

Annotta.

The seeds of the bixa orellana, which grows spontaneously in different parts of Guiana, are covered with a reddish pulp, which is collected and exported to different parts of Europe under the names of anotta, anotta, and ronce. This substance is sometimes employed for dyeing silk; and occasionally for cotton; but in either case it adheres but slightly to the stuff. It partakes so much of a resinous nature, that it is very imperfectly dissolved in water. It is therefore usual to employ at least its own weight of potash to increase its solubility, and afterwards to immerse, in the solution, the silk or cotton to be dyed, without any mordant. The colour of the anotta thus dissolved may be rendered of various shades of yellow, by destroying, by means of citric acid, the effects of the alkali. In dye-houses, where much anotta is consumed, it is put into a copper cullender, having very small holes, (being previously reduced to a state of minute division,) and the whole immersed in a copper filled with tepid water. The anotta is stirred and diffused by a stick in the form of a pestle, and passes into the bath through the holes of the cullender. The strainer is then filled with ashes from the dregs of wine, which is treated in the same manner; after which the bath is well stirred, and made to boil up, two or three times when the boiling is stopped by throwing in cold water. When the bath is not sufficiently alkalized, it produces a brick or red colour; in which case an additional quantity is applied, it is made to boil up, and the boiling stopped as before with cold water. (Chapital) In Britain, anotta is scarcely employed for any other purpose than in giving yellowish-brown tints to cotton.

Carthamus.

81. Carthamus, or bastard saffron, (carthamus tinctorius,) of which the flower only is useful in dyeing, is an annual plant, cultivated in the southern parts of Europe, Egypt, and the Levant. The flower of carthamus affords two colouring matters, one of which is soluble in water, and yields an inferior yellow; the other is resinous, and obtained by the action of the fixed alcohols. The latter alone is valuable, as it furnishes a red of greater delicacy and beauty than can be procured from any other colouring matter, though of but little durability.

82. The colour is obtained by tying up the flowers in a linen bag, and then subjecting them to maceration and pressure in clear running water, until all the yellow colouring matter which they contain is dissolved, and washed away. After this has been done, the flowers are again macerated in a solution of pure soda, just sufficient to dissolve and extract the resinous colouring matter, which is separated by draining, and the repeated effusion of portions of water, until it is wholly dissolved and carried off. A solution of the colouring matter being thus obtained, the soda is neutralized by an acid; the citric is usually preferred, and it is thought to answer the purpose best, when it is in the state in which it exists in lemons, or limes beginning to spoil. Next to the citric acid, some have recommended that of tamarinds and tartar; though Bergman prefers the sulphuric, if it be not used in excess. Scheffer affirms that the acid juice of the mountain ash produces a better, and more durable colour than even the citric acid. The expressed juice after being allowed to ferment, is bottled up, and becomes fitter for use the longer it is kept.

83. The rose colour of carthamus, extracted by soda, and afterwards detached from the alkali by citric acid, affords the basis of the beautiful paint known by the name of rouge. The colouring matter being slowly dried in the shade, is finely ground with the purest tale, and in this state is applied to give to the cheeks the lue of health and beauty, by those females who are distrustful of their native charms.

84. Archil, or archill, is a colouring matter, obtained from several species of lichens. When it is prepared for the purposes of dyeing, it is in the form of a paste, and of a red violet colour. The most valuable is extracted from the lichen roccella, (Limn,) which grows at Cape Ver, and the Canary Isles, on the rocks near the sea. Dillenius has endeavoured to shew, that this plant is the same that was used by the ancients, and held by them in such estimation, that the colour, which it afforded was reckoned more beautiful, when first dyed, even than the Tyrian purple. It is mentioned by Pliny under the name of fucus marinus, and was used in his time as a ground for that colour.

85. The knowledge of archil as a dye, was lost, however, in Europe, till about the beginning of the 14th century, when it was restored by a native of Florence, who had become acquainted with its properties during his residence in the Levant. He communicated the information he had acquired to his fellow citizens, and for a considerable time the Florentines enjoyed the exclusive use of it as a dye, as they purchased all that could be procured of it, among the islands of the Archipelago, and on the shores of the Mediterranean. After the discovery of the Canary Isles, the lichen, which yielded the archil, was found in great abundance on their coasts, and by this means the other nations of Europe were relieved of their dependence upon Italy to supply the commodity. The plants which yield this colouring matter, have also been discovered in great abundance at the Cape Verde Isles; and as they had been allowed to attain their full maturity, they were found to be richer in colouring matter than any which had been previously known.

86. Micheli has given an account of the method of preparing archill, conformable to the practice of Florence. The plant was first reduced to a fine powder, and after being passed through a sieve, was moistened slightly with stale urine. The mixture was stirred once a day, and a certain portion of soda added each time, till it acquired a dode colour. It was then put into a wooden cask, and covered with a sufficient quantity of urine, lime water, or a solution of gypsum; and in this state it was retained until wanted by the dyer. In the description given in Picotho, (a work which we mentioned under the history of dyeing,) sal ammonic, sal gom, and salt petre, are added in the preparation; but Heltot thinks, from experience, that lime and urine are the only ingredients necessary; and that the mixture ought to be frequently stirred, adding, at the same time, fresh quantities of these. It is proper when the process is completed, says Berthollet, to allow the vo-
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Substantive Colouring Matters.

Archil is a late alkali which has formed, to evaporate, that the archill may have the violet smell of that which is well prepared. To preserve it any length of time, however, it must be kept moistened with urine.

The best kind of archil is extracted from the roccella, or orchella; but this colouring matter is obtained from several other species of lichen. The French have long employed for this purpose a kind of lichen called perelle, which commonly adheres to volcanic stones or productions. The plant in question has, generally represented to be the lichen parlellus of Linneaus; but this supposition is disproved by a memoir, of M. Coecq lately published in the 81st vol. of the Annales de Chimie. He states, that in Auvergne, where the perelle is principally gathered, the true lichen parellus is called la pommelée, and is always rejected as unfit by the persons employed for this purpose. M. Coecq describes, in the same memoir, the process by which the perelle is prepared at Clermont for the use of the dyer. It appears, that the perelle is macerated and fermented in wooden troughs, which are commonly about six feet in length, two or three in breadth, (contracting towards the bottom,) and about two feet in depth. Each trough is furnished with a cover, which fits it exactly, and retains as much as possible of the volatile alkali of the human urine. About 200 lbs. of perelle and 240 lbs. of urine are mixed together in each trough, and afterwards stirred three hours, during two days and nights, taking off the cover only as often and as long as is necessary for the stirring. On the third day, 10 lbs. of sifted and stacked lime must be added, and well mixed, together with a quarter of a pound of arsenic, and an equal weight of alum. The workmen must avoid the fumes of the arsenic as much as possible, for some hours after its admixture. The stirring is then to be repeated several times, once every quarter of an hour, and afterwards every half hour, till the fermentation is established; when this is the case, the mixture need not be stirred more frequently than is necessary to prevent a crust from forming on the surface, which, by obstructing the fermenting process, would resist the complete evolution of the colour. After the fermentation has continued 48 hours, it commonly begins to diminish, and must be renewed by the addition of two lbs. more of sifted lime, and the stirring continued once every hour until the fifth day, when the frequency of stirring may be gradually diminished. After the eighth day, it is sufficient to stir the mixture every six hours, extending the process a fortnight, and even in some cases three weeks longer. The colouring matter thus prepared, is afterwards to be kept moist in close casks. It improves during the first year; suffers little change during the second; the third, it begins to decline, and becomes inferior in quality afterwards.

89. The colours obtained from cudbear prepared by these processes, possess great beauty and lustre, at first, but they quickly fade, and ought never to be employed unless for the purpose of heightening the brilliancy of some more permanent dye. The colour extracted from the roccella, or orchella, is more beautiful and less fugitive than that yielded by any other species of lichen; but none of these colours are lasting. Cudbear is chiefly employed in this country to give body and lustre to the blues dyed with indigo; it is also sometimes used as a ground for madder reds. It stains marble of a durable violet colour. Dufay says, that he has seen marble stained with this colour unaltered at the end of two years.

90. The infusion of archil is of a crimson, inclining to violet. Acids impart to it a red colour: but as it contains ammonia, by which its natural colour has been already modified, fixed alkalies produce little change on it, only rendering its colour somewhat deeper, and more inclined to violet. Alum forms with it a dark red precipitate, without rendering the colour more permanent. The nitro-muriate of tin makes the colour dyed with it to approach nearer to a crimson, which is less fugitive than when that ingredient is not employed.

91. Besides the lichens, whose colouring matter is prepared with ammonia, some of them afford substantive dyes less beautiful, but more permanent, by mere boiling with water. Of these, the musc pulmonarius of Caspar Bau- line, or the lichenoides pulmonarius reticulatum vulgare marginulus petitieris of Dillenius, known in the northern parts of England by the name of rags, or stone-mg, dyes, without any mordant, a very durable dark-brown colour upon white wool or cloth; and a fine lasting black upon wool or cloth which has previously received a dark blue from indigo. See Bancroft, Perm. Col. i. 305.

* This is contrary to what is recommended by Berthelot.
III. Of Mineral Substantive Colours.

92. The greater number of mineral substances used in dyeing, are employed chiefly with a view of attaching colouring matters to stuffs, or of heightening their lustre after they have been so applied. Some of them, however, particularly iron and copper, are occasionally employed for giving substantive colours.

Iron.

93. Iron, in every form of its solution, has a strong affinity for linen and cotton, and readily combines, in the state of an oxide, with their fibres. The colours which it affords vary with the degree of oxidation; but as the oxide, in all its combinations, is disposed to attract more oxygen from the atmosphere, these colours all terminate in the rusty colour commonly called iron-mould. This absorption of oxygen, being a kind of slow combustion, renders the oxide corrosive, and gradually injures the texture of the cloth. The rigidity which it occasions in the fibres, also renders them more brittle, and less durable. Hence iron-moulds at last produce holes. This injurious property of the oxide of iron, is in some degree counteracted by combining the oxide with other substances; but there is reason to fear, that, in every condition, the oxide of iron is hurtful to stuffs. It is to this property that the rottenness so generally complained of, with respect to the black dye, is to be ascribed.

94. The oxide of iron is usually applied to linen or cotton in combination with some acid. Vinegar was usually employed for this purpose; and the resulting salt, the acetate of iron, has long been known to dyers under the name of iron liquor. Another acid has of late been frequently substituted for the vinegar, called the pyroligneous, which is distilled from wood, and is in reality the acetic acid in combination with a portion of empyreumatic oil. This compound acid dissolves iron better than the acetic, and forms a salt which is more useful in dyeing than the acetate. The oxide combines with the acid at different stages of oxidation; but the resulting solution forms the most intimate and permanent union with the fibres of linen and cotton, when the oxidation is greatest. M. Chaptal has ascertained that the different buff colours, and the imitations of mackeen, may be greatly improved by combining the oxide of iron with alum. He accordingly first impregnates the linen or cotton with a solution of the oxide of iron in the pyroligneous, or some other vegetable acid,marking three degrees on the acometer of Beaume, and, after wringing it properly, plunges it immediately into a solution of potash marking two degrees, with which a saturated solution of alum has been mixed, but so as not to precipitate the alumine. By this mixture, the colour of the oxide is heightened, and the cloth acquires an agreeable, smooth, and soft appearance.—See Ann. de Chim. xxxi. p. 270.

95. The application of potash conjointly with an oxide of iron, is stated by Dr Bancroft to have been practised at Manchester for almost half a century. The iron was usually, but improperly, dissolved in aquafortis, as this acid acts with great energy on the fibres of linen and cotton, and soon destroys their texture.

96. The colours produced by iron, though very durable, are liable to be affected by the infusion of tea, and other substances which contain the gallic acid. The spots occasioned by these may, however, be removed by an oxymurate of potash or lime.

Copper.

97. Dr Bancroft has proposed to employ the oxides of copper as substantive colours, though the advantage to be derived from their use in this respect is extremely doubtful. He mentions that he had produced accidentally, and fixed permanently upon calico, a brownish red oxide of copper, nearly resembling the ruby copper ore in colour, which withstood repeated washing with soaps, and six weeks exposure to the atmosphere, without alteration. He thinks that this colour may prove useful by simple topical application, in calico printing; but he has not examined it sufficiently to give a decided opinion on the subject.

98. The green colour exhibited by most of the preparations of copper arises from the absorption of oxygen, for which the oxides of this metal have a strong affinity. It does not appear that any of the solutions of copper or its oxides, can be applied simply to linen or cotton, so as to resist the action of soap, though they suffer but little change from exposure to the sun and air. If liquid ammonia be saturated with copper, and thickened with gum, it may, by simple topical application, be fixed upon linen or cotton, when, by an evaporation of a part of the volatile alkali, and the absorption probably of both oxygen and carbonic acid, its blue colour will be changed into a green resembling that of verdigrise, or rather that of the malachite, which will sufficiently resist the impression of sun and air, and bear a considerable number of washings with soap, without being affected thereby. It may therefore, says Dr Bancroft, be usefully employed in this way, especially upon fine muslins, by reason of the great delicacy of its colour, and the facility of its application.—Perm. Col. i. p. 320.

99. The oxides of various other metals have been proposed to be used in dyeing; but it does not appear that any of them can be usefully or extensively employed as colouring matters upon cloth.

CHAP. III.

Of Adjective Colouring Matters.

I. Of Animal Adjective Colours.

100. The most important and valuable matter belonging to this class, is the coccus cacti of Linnaeus, or cochineal. We have already described the methods which are employed for rearing this insect, and shall therefore confine ourselves at present to an account of its qualities as a dye. See COCHINEAL.

101. Two kinds of cochineal are employed in dyeing: Cochineal, they are distinguished in Mexico by the Spanish terms grana fina, and grana sylvestra. The first variety, being of a larger size, and yielding a greater quantity of colouring matter, is reckoned the most valuable; the other is smaller, and covered with a downy substance, resembling cotton, which increases its weight, without being of any use in dyeing.

102. Cochineal which has been properly prepared, and externally carefully kept, is of a greyish colour, inclining to purple. The greyish colour is occasioned by a powder, which covers the insect in its natural state, and part of which still adheres to it; the purple shade is owing to the colouring matter extracted by the hot water in which the insect has been killed. Cochineal retains its properties for a very long time if it be properly kept. Hellot says, that he made some experiments with a quantity of it which was 150 years old, and that its properties as a dye were unchanged.

103. The colouring matter of cochineal may be extracted by water. The decoction is of a crimson colour, the solution of which inclines to violet. A little sulphuric acid being added...
to it, causes the liquor to assume a red colour, inclining to yellow, and forms a small quantity of a beautiful red precipitate. Muriatic acid produces nearly the same effect, but no precipitate. A solution of tartar converts the liquor into a yellowish red, and slowly produces a small quantity of a pale red precipitate. The supernatant liquor retains a yellow tinge, which is changed into purple by the addition of an alkali. The precipitate is quickly dissolved by the alkali, and the solution becomes purple. A solution of alum heightens the colour of the infusion, renders it redder, and produces a crimson precipitate. A mixture of alum and tartar produces a bright lively colour, inclining to a yellowish red. A solution of muriate of soda, (common salt), renders the colour somewhat deeper, but does not make the liquor turbid. Muriate of ammonia gives a purple tinge, without any precipitate. Sulphate of soda produces no change. The acetate of lead forms a purple, inclining to violet. Nitrate of lead, a delicate lively colour, between red and cinnamon, but inclining most to the former. The sulphate, nitrate, muriate, and acetate of iron, produce a dark violet, and even a full black colour, when they are used in sufficient quantity. The salts of copper and mercury debase the colouring matter of cochineal. Nitrate of zinc gives a lively bright blue colour, approaching to purple. Muriate of zinc, a colour like the last, but more of a purplish tinge. The salts of bismuth produce indifferently colours; and the same remark may be applied to the salts of cobalt, nickel, tungsten, antimony, and manganese.

104. Of all the metallic salts which affect the colour of cochineal, the most important is the oxide of tin. About the year 1650, it was discovered by the accidental falling of a solution of the nitrate of tin into a decoction of cochineal, that the colour of the latter instantly passed from purple to a vivid scarlet. Different salts of tin produce different effects; but we must reserve the particular consideration of their properties, until we come to examine the nature of mordants.

105. When alum is added to a decoction of cochineal, it combines with its colouring matter, and forms the beautiful lake called cARMINE. A certain proportion of an- taur, a bark brought from the Levant, of a colour paler than cinnamon, and in general, chouan, the seed of a plant likewise brought from the Levant, are added. Berthollet supposes that these two substances furnish, with alum, a yellow precipitate, which serves to brighten the colour of the cochineal lake. Carmine was formerly prepared from kermes, from which it takes its name, and the nature of which we shall now consider.

106. Kermes (coccus ilicis), is an insect found in several parts of Asia, and the south of Europe. It appears to have been employed at a very early period as a dye, and was known to the ancients by the name of coccus baptricus, coccus infectius, granium tinctorium. The term kermes is supposed to be of Arabic origin, and signifies a little worm. The Italians afterwards formed from it the words cernisi, cremesino, and cermesino; and the French those of carmesin, carmine, and cromosi. The English words carmine, and crimson, are of the same origin. At a later period, kermes was also called coccus scarlatinium, though the time at which it first received this appellation cannot now be accurately ascertained. The term granum was applied to it on account of its resemblance to a grain or berry; and hence colours dyed from this insect were frequently called grain, or engrain colours.

107. When the living insect is bruised, it yields a red colour, the smell of which is not unpleasant. Its taste is bitter, harsh, and pungent. In the dried state, it imparts this smell and taste to water and alcohol, giving to both a deep red colour, which is retained by the extracts made by these infusions.

108. Kermes is one of the most ancient dyes with which we are acquainted, but it has fallen greatly into disuse since the introduction of cochineal. Most of the writers on dyeing admit, that the colour which kermes imparts to wool, is inferior in beauty to the scarlet made with cochineal; Dr Bancroft, however, maintains, that by employing along with it a solution of tin or nitro- muriatic acid, he procured a scarlet in every respect as beautiful and estimable as any which can be dyed with that insect. This statement deserves attention, as the colour communicated by the kermes is more durable, and spots of grease may be discharged from it without injury. Hellot mentions that the red draperies of the figures represented in the ancient Brussels, and other Flemish tapestries, were all dyed from kermes, and that this colour, after having stood more than 200 years, seems to possess the same brilliancy as at first. Bechnam affirms the same thing with respect to some pieces of tapestry supposed to have been dyed with kermes about the twelfth century. Dr Bancroft states, that the decoction of kermes exhibits, in almost every case, the same appearances with the different chemical agents as cochineal: and he has accordingly concluded, that the colour of both is "exactly similar."

109. The coccus polonicus is a small round insect, similar to the kermes, and employed for nearly the same purposes. It is found adhering to the roots of a species of polygono- nium (severanthus perennius). Before the introduction of cochineal caused the use of it to be abandoned in Europe, it was chiefly collected in the Ukraine and other provinces of Poland, under the name Cermès. The juice of the coccus polonicus is still employed as a dye by the Turks and Armenians, particularly for wool, silk, and horse hair. The women also use it to colour their nails.

110. Several other insects might be noticed which afford a red colour, and some of them have been employed for that purpose in Europe; but the advantages offered by cochineal have entirely superseded their use, and caused them to fall into neglect.

111. Lac is a colouring matter, of animal origin, having a colour more or less red. It is produced in the East Indies by the coccus lacca, a small winged insect, and is generally deposited on the small branches of the croton laccaferum. "The fly is nourished by the tree, and there deposits its eggs, which nature has provided with the means of defending from external injury, by a collection of this lac, evidently serving the twofold purpose of a nidus and covering to the ovum and insect in its first stage, and food for the maggot in its more advanced state. The lac is formed into complete cells, finished with as much regularity and art as a honeycomb, but differently arranged. The flies are invited to deposit their eggs on the branches of the tree, by besmearing them with some of the fresh lac, steeped in water, which attracts the fly, and gives a better and a larger crop. The egg, which is about the size of an
112. The cells are filled with a glutinous liquid, which is sweetish to the taste, and of a fine red colour, soluble in water. This liquid is secreted by the insect, and is destined as a food to the embryo, from the time of its animation till able to quit its cell in quest of food. The natives of Assam use it as a dye, and cotton dipped in it makes afterwards a very good red ink. The eggs, and dark coloured glutinous liquid with which they are surrounded, communicate a very beautiful red colour to water while they are fresh; but after they have been dried and kept for some time, the colour they afford is less bright. "It would therefore be well worth while," says Dr Roxburgh, "for those who are situated near places where the lac is plentiful, to try to extract and preserve the colouring principles by such means as would prevent them being injured by keeping. I doubt not," continues he, "but in time a method may be discovered to render this colouring matter as valuable as cochineal."

113. As an article of commerce, lac is known in Europe under the appellations of stick-lac, seed-lac, and shell-lac. The first is the lac in its native state, as it is found adhering to the twigs on which it was originally deposited. The seed-lac is said to be the stick-lac broke into small pieces, and thus appearing in a granulated form. This, however, is a mistake; seed-lac being the yellowish hard resinous powder, which remains after the red colour of stick-lac has been extracted, as far as it can conveniently be done, by water. Shell-lac is produced from seed-lac, by putting the latter into long cylindrical bags of cotton cloth; melting it, by holding the bags over a charcoal fire; and when the lac melts, straining it through the cloth, by twisting the bags. The lac thus strained, is allowed to fall upon the smooth junk of a plantain tree, and is there spread into thin plates. In this form it is brought to Europe, and is chiefly employed in the composition of varnishes and sealing-wax.

114. For the purposes of dyeing, stick-lac of the deepest colour should be chosen. The colour which it affords is less brilliant than the scarlet obtained from cochineal; but it has the advantage of possessing greater durability. Berthollet says, that it may be employed to good purpose by mixing a certain quantity in the cochineal, when, if it be not in too large proportion, the scarlet will be rendered more permanent, without losing any thing of its beauty.

115. Water dissolves lac, and the decoction is of a deep crimson colour. The solubility is increased by alkaline substances. Pure potash and soda completely dissolve the different kinds of lac. Pure ammonia, and carbonate of ammonia, also act on its colouring matter. To separate the part soluble in water, and calculate its proportion to the wax or resin, Hellot used to extract it by means of water and mucilage of comfrey, to precipitate the colouring matter with alum, and to collect and dry this precipitate, the weight of which was only one fifth of the lac. This precipitate is a compound of the colouring matter and alumine: Hellot used it for dyeing.

116. Dr Bancroft seems to be of opinion, that lac employed with the nitro-muriate of tin and tartar, might be made to dye scarlets, equal in vivacity and beauty to any which have been produced from cochineal, and by the same means, taking care only to employ them in a proportion somewhat larger. He ascertained, in the course of his experiments on this substance, that water, at the ordinary temperature of the atmosphere between the tropics, dissolved and extracted almost as much of the colour of powdered stick-lac, as when assisted by a boiling heat. He discovered also, that water of this temperature extracted the colouring matter free from other substances, which were dissolved by it at the boiling point. Having carefully evaporated a few quarts of this cold infusion of powdered stick-lac, made during some warm days in the early part of September, he obtained an extract, which, when dried and rubbed in a mortar, broke readily into fine powder, and was afterwards found to dissolve almost as readily as refined sugar; and having tried this powder to dye small pieces of broad cloth, with the usual mordants, he says he had no difficulty in producing therewith scarlet colours equal to the best which could be any where found, and with little more than half as much in weight of the powder as would have been required of cochineal to produce similar colours. In consequence of these results, and considering the low price of stick-lac in the East Indies, he was convinced that this colouring matter might be successfully introduced as a substitute for cochineal. He accordingly communicated his opinion on the subject to the Chairman of the Court of Directors of the East India Company, and offered to disclose the result of his experiments, for a moderate but suitable remuneration. The Committee of Directors, before coming to a final determination, prudently proposed the dyeing of a piece of long cloth (the woollen cloth of which the Company's exports are chiefly composed,) in order that the practicability of the method might be ascertained on a sufficiently large scale; the samples which Dr Bancroft had produced being taken from small bits of cloth. The first experiment succeeded so well, that the colour produced was approved of by very competent judges; but in some subsequent trials, the results fell short of expectation, the colour being deficient in brightness. When the decoction of the lac began to acquire a little of the consistency of a soft extract, a sudden and remarkable diminution of the beautiful colour of the liquor was observed. The change was ascribed to the absorption of oxygen; Dr Bancroft having noticed a similar effect produced on logwood in the same circumstances. To obviate this inconvenience, he has proposed to obtain the extract by evaporation with the heat of the sun only; but it is extremely doubtful whether the absorption of oxygen from the atmosphere would not take place in an equal degree, during so protracted a mode of extracting the colour. He has also proposed to collect the colouring matter of lac by precipitating it from its aqueous solution by the oxide of tin, and after letting off the superincumbent water, to separate the precipitate from all the remaining moisture, by suspending it in close linen bags, and afterwards drying it in the sun, or even in the shade. One pound of nitrate of tin, in which the acid of the ordinary strength (1.170) was saturated with the metal, appeared capable of precipitating as much of the colouring matter of lac as, in its effects, would be equal to one pound of cochineal. He accordingly attempted to dye a piece of cloth with this precipitate, but owing to deficiency of colouring-matter, and other causes which lie mentions to account for the failure, the experiment was not successful. He still seems to think, however, that in this, or some other
form, lac might be used with considerable advantage as a dye, and even as a substitute for cochineal.

117. We shall conclude this division of adjective colouring matters, with a short account of those properties of Prussian blue which we have not considered under the head of Prussian acid: (See Chemistry, p. 60.) Prussian blue is a triple compound of Prussian acid, an oxide of iron, and potash. The oxide of iron may combine in different proportions with the acid; when it is in excess, the solution is yellowish, but when it is in a proper proportion, it is blue. The excess of the oxide of iron may be taken up by an acid: the muriatic is found to answer the purpose best, and when it is added, the compound becomes of a beautiful blue.

118. An alkali digested on Prussian blue or prussiate of iron, combines with the Prussian acid, and separates the iron from it. The addition of an acid which has a more powerful attraction for the alkali than the Prussiate, detaches the latter from the alkali, and a double play of affinities is brought into action. The acid which is added unites with the alkali, while the Prussian acid forms with the oxide of iron the Prussian blue. At the minimum of oxidation, iron is incapable, in whatever proportion it may be applied, of producing a blue with the Prussiate acid; and hence, if the prussiate of potash be added to a recently prepared sulphate of iron, the precipitate is white, and remains colourless until it absorbs oxygen from the atmosphere. Berthollet supposes that the white prussiate of iron differs from the blue, not because it is less oxygenated, but because the sulphuric acid in the green sulphate of iron adheres more strongly to its basis than when the iron is more highly oxidized; and as a proof of this, he states, that, by adding the muriatic, the sulphuric, or phosphorous acids to the white prussiate, it becomes blue, though none of these acids can afford oxygen.

119. Whatever theoretical opinion may be entertained with respect to the cause of the formation of Prussian blue, the uncommon beauty and lustre of the colour itself have recommended it as a dye, and occasioned various attempts to fix it equally and permanently upon cloth. No method which has hereunto been proposed can be said to have completely answered the purpose; for whatever care has been taken, the colour is frequently weak and dull, and always uneven. Dr Bancroft has indeed described a method, (which we shall afterwards notice,) by which, he says, he was able to obviate the difficulties hitherto attending the use of this colouring matter. Some pieces of cloth so dyed possessed an intensely full colour, and a lustre greatly surpassing every thing before seen in wool, equaling even the transparency and brilliancy of the finest sapphire to such a degree, that the eye which has once seen the Prussian blue so communicatéd, disclaims afterwards to fix itself upon the common indigo blue.

120. The Prussian acid produces coloured compounds with other metallic oxides besides those of iron. The most remarkable, and perhaps the most important of these, is the red prussiate of copper. This colour was obtained by Dr Bancroft from the different solutions of copper in the sulphuric, the nitric, the muriatic, and the acetic acids, and particularly well by that in the volatile alkali. The prussiate of copper is distinguished from the prussiate of iron by its extraordinary permanency; for though all the alkalis readily decompose the Prussian blue, they have no effect upon the combination of the Prussian acid with copper. Such, indeed, is its durability, that neither the acids nor washings with soap, however numerous, nor exposure to the weather for the longest space of time, seem capable, in the least degree, of diminishing either its body or its lustre. Dr Bancroft says, that this colour might prove highly useful, by way of topical application upon cottons, and perhaps in dyeing cotton yarn for stripes of muslins, borders of handkerchiefs, &c.

II. Of Vegetable Adjective Colours.

121. One of the most important colouring matters belonging to this class is madder. This substance is the root of a plant, which Linnaeus divides into two species, the rubia tinctorum folis sents, and the rubia peregrina folis quadrata. The madder, in a state of preparation for dyeing, is distinguished into different sorts: that obtained from the principal roots is called grape madder, and that produced from the stalks, which, by being buried in the earth, are transformed into roots, non grape. When the madder roots are gathered, the latter are separated to form the non grape, together with the fibres of the roots, which do not exceed a certain degree of thickness, and also such as are too thick, and contain much woody matter. The best roots are about the thickness of a goose quill; they are semitransparent, of a reddish colour, with a strong smell, and a smooth bark.

122. If the roots of madder be examined with a microscope, the interior part is observed to contain a considerable proportion of specks of a bright red colour; but the ligneous part which surrounds these, as well as the bark, abounds with a brownish yellow colouring matter, which tends greatly to degrade the red that madder would otherwise afford. The pernicious effects of this yellow matter, when madder is used as a dye, may in some degree be avoided, by extracting the colouring matter in water which is but moderately warm, the yellow matter being but imperfectly dissolved so long as the heat is below the boiling point. The outer bark and ligneous parts are also more easily pounded than the parachymatous parts, to which the red colour is more immediately attached, and, on this account, a separation may, to a certain extent, be effected by mechanical means. This separation is established among the French dyers the distinction of madder into rober, mis-robee, and courte. After the first operation of the mill, the madder is passed through a sieve with a cover fitted to it, and, by this means, what is called the short madder, which is used for inferior colours, is obtained; the remainder being again ground and sifted, produces the mis-robee; and a third operation affords the robee or finest madder.

123. Water of the ordinary temperature of the atmosphere may be made to dissolve almost all the red colouring matter from madder; but for this purpose it must be employed in large quantity; and the colour is more beautiful when the solution is obtained by cold than by hot water. Alkalies increase the dissolving power of water, particularly with respect to the yellow matter. The residuum is very inconsiderable, so that madder appears to consist almost wholly of colouring matter. The latter portions of the extract, which seems to be chiefly yielded by the ligneous and cortical parts, is fawn-coloured.

124. The red colouring matter of madder is soluble in alcohol, and, on evaporation, a deep red residuum is

* Except the oxymuriatic, which decomposes it.
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125. D'Ambourney and some others pretend, that the roots of madder may be used with greater advantage when they are freshly gathered, than after they have been kept for some time, and reduced to the state of powder. This assertion, however, is by no means countenanced by the general experience of practical dyers, who find, that, if properly dried, and carefully preserved from moisture, madder improves by keeping, at least during the two first years.

Chay. Yields a colour inferior to madder.

126. The colour yielded by the chay, chayuver of the Tamula, which Dr Roxburgh has ascertained to be a species of oldelandia, is nearly allied to that of madder. This plant is a small biennial, rarely a triennial, growing spontaneously on light sandy soils, and extensively cultivated on the Coromandel coast. The cultivated roots are very slender, and from one to two feet in length; the wild are shorter, and yield more colouring matter, which is also of a superior quality. The colour, which is of an orange hue, seems to reside almost entirely in the bark of the roots.

127. The chay root is said to be extensively employed as a dye in India; but the colours obtained from it, by those who have examined its properties in this country, do not warrant us to recommend its importation. Dr Bancroft states, that the best specimens of it which he could procure, did not seem, in any instance, to yield a colour superior to that of madder, but, in general, greatly inferior both in beauty and durability. With the solutions of tin, it produced a very bright and lasting red on wool; though, like that of madder, it inclined too much to the orange. With the oxides of iron it produced nothing darker than drab colours, either upon wool or cotton. Broad cloth dyed without any basis, acquired from chay root a brownish red, which was neither so bright nor so durable as that which it assumes in the same way from madder.

128. The colouring matter yielded by the roots of galium, a genus of plants belonging to the same order as the preceding, differs but little from that of madder; only when the brown external covering of the root is removed, the colour which it imparts to wool is somewhat brighter, with an aluminium basis. The several species of galium chiefly employed in dyeing, are the following: Galium tinctorium, galium verum, galium mollugo, galium sylvaticum, galium boreale, galium aparine. The galium tinctorium is found in great abundance in the woods of North America, and its roots are employed by the native inhabitants to dye porcupine quills of a red colour. The galium verum, yellow ladies' bed-straw, or cheese remaining, affords a colour which is but little inferior to the scarlets dyed with cochineal. The roots, which afford the colouring matter, are covered by a very dark bark, which must be removed, to prevent its affecting the colour of the rest of the root. The dye thus obtained is employed by the people of the Highlands, and of some of the islands of Scotland, for giving a bright red to their woollen stuffs. The galium mollugo and the galium sylvaticum, yield a colour equally bright and lasting. The galium boreale is said to afford a more brilliant red than any other species. Its roots are used as a dye by the inhabitants of Switzerland. The galium aparine, common rough ladies bed-straw, cleaners, or goose grass, also affords a red dye, but inferior to the last. Dr Bancroft has noticed a variety of other colouring matters nearly allied to madder, but their properties are too unimportant to merit consideration in this work; we shall therefore now proceed to make some observations on Brazil wood.

129. Brazil wood, as an article used in dyeing, is the heart, or central part, of a large tree which grows in Brazil. Berthollet states, that it derives its name from that part of South America; but Dr Bancroft has decidedly proved, that the country took its name from the wood, not the wood from the country. Brazil wood is mentioned in some old charters, particularly one dated in 1398, and another in 1306, under the name of Brazilis, which, as well as Brasilia, is understood to be derived from Brazilis, a burning coal, to denote its fiery red, or flame colour. It is also called Farnambucca, wood of St Martha, of Japan; and of Sans. Linnaeus describes the tree which furnishes Brazil wood under the name Cassapina crista; which gives the Japan or sappan wood, by the name Cassapina sappan; and that of Antilles, which is the least esteemed, he calls Cassapina vesicaria. That which comes from Farnambucca is the most valuable.

130. Brazil wood is very hard, and takes a good polish. It is pale when first cut, but reddens by exposure to the air. It sinks in water, and its goodness is known by its weight. Boiling water extracts the whole of its colouring matter, and becomes of a fine red if the boiling be continued sufficiently long. A black residue remains, which still yields much colouring matter to alkalis. A more perfect solution is obtained by alcohol, and also by ammonia; at least the colour is deeper. The practice of sprinkling the powder of Brazil wood, during the operation of grinding it, with starch, probably raises the colour, by means of the volatile alkali which it contains.

131. Fresh decoction of Brazil wood yields, by the addition of sulphuric acid, a small quantity of a red precipitate, inclining to fawn colour; the liquor remains yellow and transparent. Nitric acid renders the liquor yellow at first; but if more be added, the liquor acquires a deep orange colour, and becomes transparent, after having deposited a precipitate nearly resembling the former in colour, but more copious. Muriaic acid produces the same effects as the sulphuric. Oxalic acid produces a precipitate of an orange red, nearly as copious as the nitric acid does. The liquor remains transparent, and of the same colour as in the former trials. Distilled vinegar gives a very little precipitate of the same colour: the liquor remaining transparent, and a little more inclining to orange. Tartar furnishes still less precipitate, and leaves the liquor turbid. Fixed alkali restores the decoction to a crimson, or deep violet inclining to brown. Ammonic gives a brighter purple, or violet, and a little precipitate of a fine purple. Alum occasions a red precipitate inclining to crimson: the liquor also affords a copious precipitate on saturating the acid of the alum with alkali. In this way an
extracting the colour of red saunders by alcohol, he
communicated to wool a colour almost equal to scarlet.
A very bright and lasting orange may be given to
broad-cloth, prepared, as usual, with alum and tartar,
by employing equal portions of ground sumach and
red saunders.

137. The wood of the Hematoxylon Campechianum
affords a colouring matter, which is used very exten-
sively in dyeing. In commerce, it is known by
the name of logwood, and also of India or Campeachy
wood. Logwood is so heavy as to sink in water; it
possesses great hardness, and, by the compactness
of its grain, takes a fine polish. Its prevailing colour
is brown, tinged with shades of orange, yellow, and
brownish black, and is extracted in the same manner as that of
Brazil-wood. Six quarts of distilled boiling water are
capable of extracting almost all the colouring matter
of one pound of logwood properly chopped. The
decotion is of a yellow colour, and has a sweetish taste.
If the decoction be made with common water, it ex-
hibits a full red, or dark blood colour, probably by the
action of the calcareous earth which common water
usually contains in combination with it; but by adding
to it sulphuric, nitric, or muriatic acid, the yellow is
restored.

138. When logwood is of a good quality, it yields
from one-fifteenth to one-twentieth of its weight of
pure colouring matter, soluble in water and in alcohol,
if the decoction after being obtained has been speedily
evaporated to dryness; but if an interval of several
weeks has been allowed to intervene, or if the evapo-
ration has been conducted slowly, and the decoction
has been exposed to the sun and air, the colouring mat-
terial will absorb a large quantity of oxygen from the
atmosphere, and become nearly insoluble in water,
while the colours dyed from it will be more fugitive
than those produced by a decoction recently prepared.
In this respect it differs greatly from Brazil wood.

139. Chips of logwood being boiled in water acidulat-
ed with sulphuric acid, afford a brownish yellow deco-
cion, which communicates to wool a strong yellowish
bright snuff colour, of considerable durability. Nitric
acid being mixed with a decoction of logwood, produces a
fine bright yellow, which becomes a yellowish brown
by boiling, and imparts the same colour to wool. Cloth
boiled with a decoction of logwood, slightly acidulated
by muriatic acid, takes a brownish yellow colour.
If a sufficient quantity of alum be added to a decoction
of logwood, the colouring matter is all precipitated in
combination with the alumine, of a purple or reddish
violet colour. A sulphate of iron occasions a copious
bluish black precipitate. All the solutions of tin pro-
duce purple or violet colours, and a complete precipi-
tation of the colouring matter. Sulphate of copper gives
a purplish blue colour; sulphate of pure zinc, a dark
purple; muriate of mercury, an orange red; muriate
of antimony, a beautiful crimson; acetate of lead, a
black precipitate, with a slight tinge of red; muriate
of laries, a reddish purple; muriate of magnesia, a
yellow; sulphate of lime, a purple; arseniate of pot-
ash, a deep yellow.

140. The best and most permanent of the purple or
violet colours obtained from logwood, are produced
by mordants, principally composed of the solutions of
tin. In another part of this article, we shall describe
the process employed for dyeing in this way upon wool,
a colour which was very fashionable in France, upwards
of thirty years ago, under the name of Prune de Mon-
sieur. Wool dyed with logwood, and either sulphate

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of copper or verdigris, acquires a blue colour, of little brightness and durability, which is chiefly recommended by its cheapness. The high price of indigo has of late rendered this mode of dyeing blue very general, particularly in France.

141. The principal consumption of logwood is for blacks, to which it gives a lustre and velvety cast, and for greys of certain shades. It is also employed very extensively for different compound colours, which it would be difficult to obtain of equal beauty and variety, from colouring matters of a more permanent nature. It is frequently mixed with Brazil wood, to render colours deeper, the proportion of the two woods being varied according to the shade desired. In short, no colouring matter with which we are acquainted, is capable of affording so great a variety of dyes, though this advantage is much diminished by their want of permanency.

Quercitron.

142. The bark of the quercus nigra of Linnaeus affords a yellow dye, which is at present very generally employed. This substance was first prepared as a dye by Dr Bancroft; he having given it the name of quercitron, by which it is now universally recognized. "The bark of the quercus nigra appears," according to his account, "to consist of three parts or coats. 1st, The epidermis, or external coat, through which the several excretions of the tree are transmitted, which, in part at least, adhere to its outer surface, and become almost black by condensation. 2d, The middle or cellular coat, in which the colouring matter principally resides. 3d, The interior or cortical part, consisting chiefly of lamina, formed by the reunion of different vessels, which become more hard and fibrous as they are placed nearest to the woody part of the tree, and have therefore less room to contain the colouring matter."

143. Before extracting the colour from the bark, the epidermis, or external covering, ought to be removed, by shaving. The remaining parts being then properly ground by mill-stones, separate partly into a light fine powder, and partly into stringy filaments or fibres, which last yield but about half as much colour as the powder, and therefore care should be always taken to employ both together, and as nearly as possible in their natural proportions, otherwise the quantity of colour produced may either greatly exceed or fall short of what is expected. The querciton bark thus prepared and proportioned, says Dr Bancroft, will generally yield as much colour as eight or ten times its weight of the weld plant, and about four times as much as its weight of the chipped old rustic. The colouring matter, continues he, most nearly resembles that of the weld plant, with this advantage, however, that it is capable alone of producing more cheaply all, or very nearly all, the effects of every other yellow dyeing drug; and, moreover, some effects which are not attainable by any other means yet known.

144. The colouring matter of quercitron readily dissolves in water, even at a blood heat. If the infusion be strained and left at rest, a quantity of resinous matter settles in the form of a whitish powder, which produces the same effects in dyeing as the part remaining in solution. The clear effusion being evaporated and dried, affords an extract equal in weight to about one twelfth of the bark from which it was obtained. Much care, however, must be employed in procuring this extract, so as to make it produce colours equal in beauty to those obtained directly from the bark itself. If the evaporation be carried on rapidly, and the heat be too great, the colour is tarnished, probably, as Dr Bancroft conjectures, from the absorption of oxygen, the colour thus undergoing a sort of semi-combustion. On the other hand, if the evaporation be conducted too slowly, the colouring matter suffers another change, and soon spoils by keeping.

145. The decoction of quercitron is of a yellowish brown colour, which is darkened by alkalis, and brightened by acids. A solution of alum being added to it, separates a small portion of the colouring matter, which subsides in the form of a deep yellow precipitate. The solutions of tin produce a more copious precipitate, and of a beautiful lively yellow colour. Sulphate of iron causes a copious olive precipitate; sulphate of copper, a yellow of an olive cast.

146. The weld plant, (Reseda luteola,) seems to have been employed from the remotest times as a yellow dye. Two sorts of it are distinguished, the cultivated and the wild; the former is preferred, as it yields more colouring matter. The wild species differs from the cultivated, in producing taller and stronger stalks. The whole of the plant is used in dyeing.

147. A strong decoction of weld is of a yellow colour, Properties inclining to brown; if it be greatly diluted with water, of the det- sits yellow, which is more or less pale, has a greenish tinge. The addition of an alkali deepens the colour of the decoction, and after a certain time a little ash-coloured precipitate is thrown down, which is insoluble in alkalis. The action of the alkali renders its colour paler, and produce a little precipitate which dissolves in alkalis, and gives them a yellowish brown colour. Alum occasions a yellowish precipitate, and the liquor retains a fine lemon colour. The solutions of tin produce a copious bright yellow precipitate. Sulphate of iron produces a copious dark grey precipitate, and the supernatant liquor is brownish. Sulphate of copper causes a brownish green precipitate, and the liquors preserve a pale green colour.

148. To extract the colour of weld for dyeing the plant is boiled in a fresh bath, inclosing it in a bag of thin linen, and keeping it from rising to the top by means of a heavy wooden cross. Some dyers continue the boiling till it sinks to the bottom of the copper, and then let a cross down upon it; others when it is boiled, take it out with a rake, and throw it away. The decoction should be employed as soon as possible after it has been prepared, as it soon suffers a decomposition, which renders it useless.

149. Common salt added to the weld bath, renders its colour richer and deeper; sulphate of lime or gypsum also deepens it. Alum renders it paler, but more lively; and tartar still paler. Sulphate of iron makes it incline to brown. The shades obtained from weld may be modified, with these additions, by the proportion of the weld, by the length of the operation, and by the mordants employed in preparing the stuff. The colour may be modified also by passing the cloth, when it is taken out of the bath, through other dyes.

150. Dr Bancroft has stated several objections to the use of weld, compared with quercitron, as a dye. When compared with those of querciton it is nearly, if not wholly, free from these defects. It is obvious, however, that, in many cases, these qualities must recommend the use of weld.
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Adjective Colouring Matters.

Fustic.

Properties of the decoction.

151. Fustic, the wood of the morus tinctoria, a tree of considerable size, which grows in various parts of the West Indies, affords a yellow colouring matter, which is very extensively used in dyeing. The colour which it yields is neither high nor bright, but it possesses considerable durability, and is less affected by acids than the quercitron and weld yellows. Fustic abounds much in colouring particles, though in this respect it is greatly inferior to quercitron, as it only affords one-fourth the quantity of colouring matter.

152. A strong decoction of fustic is of deep reddish yellow colour, which becomes an orange yellow when diluted with water. The greater number of the acids render this liquor turbid; a small quantity of a greenish yellow precipitate is formed, and the supernatant liquor is of a pale yellow. Alkalies redissolve the precipitate, and give the liquor a deep reddish colour. Alum forms a small precipitate of a yellow colour; alum and tartar a like precipitate. Muriate of soda makes the liquor a little more deeply coloured, without producing any precipitate. Sulphate of iron forms a precipitate, which is at first yellow, but afterwards becomes more and more brown. Sulphate yields a copious brownish yellow precipitate. Fustic and weld are sometimes used together, in quantities proportioned to the desired effect. Fustic is also very commonly employed with the sulphate of indigo, in dyeing Saxon greens upon cloth.

153. Fustic, as well as many other woods which yield a yellow colour, contains a quantity of resinous and extractive matter in combination with a portion of tannin. This last principle diminishes the brilliancy of the yellow afforded by fustic; but Chaptal has proposed an easy method of detaching it from the colouring matter, though it may affect its durability. The method to which we allude, is founded upon the attraction of tannin for glue. He accordingly recommends that animal substances, containing gelatinous matter, such as bits of leather, glue, &c. should be added to the decoctions of fustic. This process precipitates the tannin, and enables the colour to exhibit greater brilliancy.

154. Venice sumach, the wood of the rhoe cotinus, a shrub growing principally in Italy, and the South of France, affords a full high yellow of little durability. Dr Bancroft, indeed, mentions that this defect may, in a great degree, be remedied, by employing tartar, along with the muriate of tin, the mordant by means of which this colouring matter is usually fixed. Four pounds of the rhoe cotinus chipped, afford no more colour than one pound of quercitron. It is frequently mixed with other colouring substances, particularly cochineal, to give a fine colour to scarlet; also for pomegranates, oranges, jonquilles, gold colours, buff, and in general for all those colours which it is wished should have an orange cast.

155. Common sumach, (rhoe cotinum,) a shrub, growing naturally in Syria, Palestine, Spain, Portugal, and some parts of North America, yields a pale yellow dye, with the aluminous basis. The infusion, which is obtained from the wood previously reduced to powder by a mill, is of a greenish fawn colour, but it soon becomes brown by exposure to the air.

156. A solution of potash produces very little change on it, while recent; acids brighten its colour, and turn it yellow. A solution of alum renders it turbid, and produces a small yellow precipitate. Of all astringents, sumach bears the greatest resemblance to galls. The precipitate which it produces with solutions of iron is less in quantity than what is obtained by an equal weight of galls, but it is very copious, and may be substituted for them by increasing the quantity.

157. Sumach alone gives a lawn colour inclining to green; but cotton stuffs, which have been impregnated with the acetate of alum, take from it a very good durable yellow. It is principally employed for drab and dove colours in calico printing, and for dyeing black with iron, and the solutions of that metal.

158. The berries of the rhoeus cotinaria give a yellow dye, but one which is destitute of durability. They are chiefly used for topical dyeing, in calico printing. The colour which they communicate is so very fugitive, that the practice of dyeing from them should be abandoned.

159. Saw-wort, serrulata tinctoria, affords a better dye, and may be used as a substitute for weld with the aluminous basis. It yields a bright lemon yellow of considerable permanency, which may be heightened with the nitromuriate of tin and tartar.

CHAP. IV.

Of the Durability of Colours.

160. In the view which we have hitherto taken of colouring matters, we have considered the mechanical methods by which they are separated from the substances with which they exist in a state of combination, and the general appearances which they exhibit with a variety of chemical agents. In describing these appearances, we treated them rather as modifications produced upon the original colouring matters, than as actual changes effected in their composition. It must be evident, however, that, from the nature of the chemical agents to which, in some instances, the colouring matters were submitted, decompositions must have taken place, and new compounds been formed; and that these compounds must be more or less durable in proportion as they are capable of resisting the action of the substances to which they are afterwards to be most frequently exposed, viz. light, air, water, acids, alkalies, and soap.

161. The influence of light upon colouring matters has been long known; but it was reserved for the delicate precision of modern analysis to discover the mode of its operation. To do this, a knowledge of the composition of light itself, the most subtle of all material substances, was no less necessary than an acquaintance with the constitution of coloured bodies. Without entering into any detail on this subject, it will be sufficient to state the results which have been obtained by experiment.

162. Light appears to consist of three kind of rays, which form one homogeneous compound in the solar beam. These have been termed calorific, colorific, and deaquilizing rays: (See Chemistry, p. 32.) It is the nature of the latter which we propose to consider more particularly at present. The deaquilizing rays exert their agency chiefly in occasioning decomposition. The element which they most frequently detach from a state of combination with other bodies, is oxygen; and from this property, indeed, they derive their name. Colourless nitric acid exposed to the rays of the sun soon becomes red and fuming, a state which is known to proceed from a partial separation of its oxygen. Oxy-

The influence of light in evolving oxygen is equally demonstrated by this experiment, whether we retain the old opinion respecting this gas, or adopt the hypothesis of Sir Humphry Davy.
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165. It appears, that, in some cases, the absorption of oxygen by the colouring matter produces a change of colour, in consequence of the oxygen combining with the hydrogen, and thus forming water; so that the change which takes place is rather to be ascribed to the separation of hydrogen, than to the permanent union of the oxygen with the colouring particles. Berthollet observed, that the oxyymuriatic acid exhibited different phenomena with the colouring matter; that sometimes it discharged their colour and rendered them white; that most frequently they changed to a yellow, fawn colour, brown, or black, according to the intensity of its action; and that, when their colour appeared only discharged or rendered white, heat, or a length of time, was capable of rendering them yellow. He concluded, that the effects of the oxyymuriatic acid were similar to those of carbonization, occasioning a destruction of the hydrogen, which, combining with the oxygen more easily, and at a lower temperature than charcoal does, leaves the latter predominant; so that the natural colour of charcoal is more or less blended with the original colour.

166. From what has been stated, it appears, that changes may be produced in the colours of bodies, either by the separation of oxygen, or by the union of that principle with one of the elements of the colouring matter. In the latter case, which applies chiefly to vegetable substances, the oxygen combines with the hydrogen; the attraction of the colouring particles for their basis is thus weakened, and they are easily carried off by water. This effect takes place more or less rapidly, according to the nature of the colouring particles, or rather, according to the properties which they possess in the state of combination into which they have entered. Colouring substances, therefore, resist the action of the air the less they are disposed to unite with oxygen, and thereby to suffer, more or less quickly, a smaller or a greater degree of combustion. Light promotes this effect, which, in many cases, is not produced without its assistance; but the colouring matter, in its separate state, is more liable to suffer this combustion than when united to a substance such as alumine, which may either defend it by its own power of resisting combustion, or, by attracting it strongly, weaken its action on other substances, which is the chief effect of mordants; and, finally, this last compound acquires still greater durability when it is capable of combining intimately with the stuff.

167. Dr Bancroft has stated several objections to this theory, some of which appear to possess considerable weight, while others are founded upon limited views of the subject. Berthollet has stated, that, in consequence of oxygen combining with the hydrogen of colouring matter, the charcoal becomes predominant, and manifests its presence by the brownish appearance which the colouring matter exhibits. Dr Bancroft seems to conceive, that this explanation implied, that charcoal existed in vegetable matters in the same state in which it is found in charred wood, and that it was naturally of a black colour; but this supposition is by no means necessary for the truth of the theory. It is a certain fact, that in whatever way the carbonization of vegetable matter is effected, the charcoal obtained is always of a dark colour; this is the case, whether the vegetable matter be subjected to combustion in close vessels, or placed in a situation (under water, for example) where the volatile matters either make their escape, or unite with the bodies with which they are in contact. The charcoal thus obtained, may not have the same state in the vegetable substance from which it has been procured; and, indeed, there is every reason to conclude, that charcoal is a combination of oxygen and pure carbon; but, at any rate, it is enough for M. Berthollet to state, in support of his opinion, that in all cases when the volatile parts of vegetable matter have made their escape, the carbonaceous part which remains behind is black. We conceive, therefore, that Dr Bancroft has done nothing to disprove the correctness of Berthollet's opinion, by simply maintaining, that "he should never be convinced that these matters had originally contained ready formed black charcoal, and that the degradation of the faded or injured colour, resulted from a greater manifestation, and pre-
Durability of Colours.

Oxymuriatic acid used as a test of the durability of colour.

169. "When, therefore, we wish," continues he, "to compare together two or more colouring substances of the same nature, and to determine the relative quality and quantity of the colouring particles in each, we need only compare the quantities of the same oxygenated muriatic acid required to produce the same degree of deterioration in an equal weight of each; the qualities of these substances, or the quantity of colouring particles they contain, are directly proportionate to the quantities of liquor required to produce the same effect on each; but, in this experiment, it is necessary that the colouring matter of each substance should have been dissolved in a proper liquor, and that all the circumstances in the process of comparison should be similar. If we wish, for example, to compare several kinds of indigo, we take an equal weight of each, powder them carefully, and mix them into separate matrices. With eight times their weight of concentrated sulphuric acid: These are to be kept for twenty-four hours, in a heat of from 30° to 40° (86° to 104° of Fahrenheit). Each solution is then to be diluted with a quantity of water, filtered, and the residue found on the filters to be collected, and ground in a glass mortar, and again digested with the addition of a little more sulphuric acid: the last solutions are also diluted with equal quantities of water, filtered, and each added to its corresponding liquor. Finally, to each solution is added as much oxygenated muriatic acid as will discharge the colour, or rather bring them all to the same shade of yellow. The qualities of the different kinds of indigo, are proportionate to the quantities of oxygenated muriatic acid required to destroy their colour. The proofs of such colouring particles as are soluble in water, are much more simple: it is only requisite, after having extracted them as much as possible, to mix oxygenated muriatic acid with equal bulbs of the juice, of the same weight of each substance, and to compare the quantity of acid required to bring them all to the same hue."

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170. Though we are inclined to adopt the general principles of Berthollet's theory, and to admit, that the oxygen of the atmosphere and the oxymuriatic acid act upon colouring matters in a manner somewhat similar, we are not disposed to believe, with this eminent chemist, that the mode of action in the two cases is exactly alike, or, that the effects produced by the one afford a precise criterion of the nature of the operation of the other. Dr Bancroft has very justly remarked, that the properties of oxygen are greatly diversified by its union with other bodies; and that, in selecting the oxymuriatic acid as an accurate test of the changes which colouring matters suffer from exposure to the air, Berthollet entirely overlooked the action of the basis with which the oxygen is united; though there cannot be a doubt, that so powerful an agent as the muriatic acid must greatly modify the effects of the oxygen. Dr Bancroft mentions several experiments which add considerable weight to his objections, and, at least, prove, that the oxymuriatic acid cannot, in all cases, be considered as an accurate test of the durability of colour. He put into a small phial cuttings from three skins of cotton yarn, which had been dyed and sent to him by Chaptal. One of these had received the Turkey red, another the Nankeen buff from an oxide of iron, and the third a black from madder and galls, as he supposed, applied upon the basis of iron dissolved by the pyrogallol. "Unhappy," says he, "I poured oxymuriatic acid, which had been prepared by Mr Accoum, and kept secluded from light. Its acidity was so slight as to be hardly perceptible to the taste, and, I believe, it might have been put into the eye without occasioning much pain. I found, however, that in less than two minutes the colour of the Turkey red was much impaired, and, in five, the yarn throughout the greater part of its surface had become while, without passing through any intermediate colour; and, at the end of half an hour, but a very few sparks of red, less than a pin's head, were perceptible. The buff colour, at that time, was found to have acquired a little body, and the black to have lost a little, but without ceasing to be still a good black. At the same time, I put other cuttings of the same colours into another phial, and poured upon them undiluted aquafortis as prepared for the scarlet dyers; and I found, that, in a single minute, the black, which had withstood the oxymuriatic acid, was changed to a buff colour, resulting solely from the ferruginous basis with which it had been dyed; and the Turkey red began to exhibit the appearance of a scarlet, inclining to the orange; and this last (of a lively tint) became apparently its settled colour at the end of an hour, when the buff, by acquiring more oxygen, was considerably raised. Here, then, was a very great diversity between the effect of the nitric and the oxymuriatic acids, in no degree according or proportionate to their degrees of acidity; that of the nitric acid being at least fifty, and perhaps one hundred times greater than that of the oxymuriatic acid, (which being tasted at the time when its action upon the Turkey red was strongest, and when, according to Davy's opinion, it must have already decomposed water, had not, to my taste, acquired any greater degree of acidity); and yet the former could only change the complexion of the Turkey red to a bright orange, (probably by imparting oxygen to it,) whilst the latter (not, as I conceive, by any such, or other addition, but by a complete decomposition,) had at once annihilated all the colour (leaving the cotton yarn white) as fast and as far, as the decomposition took.
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place; and this without any intermediate tint, which would not have been the case, if the effect of the oxymuriatic acid had, as M. Berthollet supposes, resembled combustion. And, on the other hand, the black, on which the oxymuriatic acid could make but a very slight impression, was completely destroyed (excepting the colour of its ferruginous basis) by the nitric acid. Dr Bancroft accordingly infers, that the powerful action exerted by the oxymuriatic acid on colouring matters, does not result from the abstraction of its oxygen, but from some quality peculiar to itself; "from the combined agency of its constituent parts, and not from the action of either separately, as has been supposed."

It is obvious, however, that, in reasoning concerning the effects of the nitric and oxymuriatic acids, the Doctor has confounded two things which are perfectly distinct: the acidity of these bodies, and their disposition to part with their oxygen. Even admitting that the quantity of oxygen contained in acid bodies was proportional to their acidity, it would not follow, that the most acid substances would most readily impart their oxygen to other bodies. The nitrous oxide supports combustion with a brilliancy little inferior to oxygen gas itself; the nitric oxide, which, with the same base, contains double the quantity of oxygen, so far from supporting combustion, immediately extinguishes the greater number of burning bodies which are plunged into it. It cannot be inferred, therefore, that, because nitric acid possesses greater acidity than oxymuriatic acid, the former must necessarily give out more oxygen than the latter, to the substances brought within the spheres of their activity. But though this argument is by no means conclusive with respect to the dissimilarity of effect produced by atmospheric air and oxymuriatic acid, and though several explanations might be offered to account for the different results obtained in the preceding experiments, in perfect consistency with Berthollet's theory, the following facts, which Dr Bancroft has stated, certainly tend to prove, that whatever analogy may hold between the action of common air and oxymuriatic acid, the latter cannot be regarded, in all cases, as a measure or indication of what colours would suffer by exposure to sun and air.

172. He put into an empty glass-stopped phial, the following colours upon separate bits of muslin, viz.:--

"1st. A fast madder-red, dyed topically by an eminent calico printer, upon a basis, from acetate of alumine applied by the block.

"2d. A fast yellow, dyed from weld upon the same basis, by the same calico printer.

"3d. A fast yellow, dyed upon the same basis, from quercitron bark.

"4th. A fine durable purple, produced by the colouring matter of the buccinum lapillus.

"5th. A logwood purple, produced by mixing with a strong decocation of that wood as much muriate of tin as rendered the former slightly acid, and, after thickening the mixture with gum-arabic, applying it in spots to muslin; which, after being properly dried, was washed with soap and water.

"6th. A full bright yellow, produced from a similar decoction of the quercitron bark rendered slightly acid by an admixture of nitro-muriate of tin, made with two parts of nitric to one part of muriatic acid; gummed and topically applied in the same manner as the logwood purple, and in like manner dried, and afterwards washed.

"7th. A similar yellow, made from the quercitron bark, only substituting muri-sulphate of tin for the nitro-muriate."

173. "Upon these colours," says Dr Bancroft, "I poured oxymuriatic acid, with which Mr Accam had recently supplied me, (and which I had kept secluded from the light) until the phial was full; after which, in less than two minutes, I found that the bits of muslin, with the madder, weld, and quercitron colours, dyed upon the aluminous basis, were become perfectly white, by a complete extinction of their several colours. Whilst the logwood purple, that from the buccinum, and the quercitron yellows, with solutions of tin, were not apparently changed. But, in about five minutes, the logwood purple appeared to be losing body, as did the quercitron yellows soon after; and a similar effect soon became evident in the shell purple. In about fifteen minutes from the time when these colours were immersed in the oxymuriatic acid, the logwood purple had nearly disappeared; and this was the case of the quercitron yellows in about three minutes afterwards, and of the shell purple about two minutes later; excepting the red spot of the latter, as well as a part of one of the yellows given with tin, had each preserved a portion of colour, by having been protected by the bits of muslin from the sun's rays, which, as the sky was clear, had had free access to the phial containing them at the window where this experiment was made; a fact which manifested the influence of solar light in promoting the destructive action of the oxymuriatic acid on the colours in question. It is here to be recollected," continues he, "that the three first-mentioned colours, dyed upon the aluminous basis, would have resisted the action of sun and air for two or three months, and the madder for a much longer time; and yet they were completely destroyed in an eighth part of the time which was required to destroy the logwood purple, and the yellows with tin; neither of which could have been exposed to the sun and air for a single week without becoming of a faded brown. It is also worthy of observation, that the Tyrian or shell purple was destroyed by the oxymuriatic acid almost as soon as the logwood purple and quercitron yellows last mentioned, though it would have resisted the sun and air probably fifty times longer than either of them." These experiments certainly show, that whatever similarity may subsist between the effects of oxymuriatic acid and atmospheric air on colouring matters, the former cannot be regarded as the very accurate test of the durability of colours, which Berthollet was disposed to represent it. Indeed, the only sure mode of determining the durability of colours, appears to be direct exposure to air, sun, water, and the other agents to which dyed stuffs are most frequently exposed. We shall therefore subjoin the observations of Hellot on this subject, together with his account of the methods employed by Dufay, which laid the foundation of the regulations adopted by the French government respecting fading and durable colours: "The late Mr Dufay," says Hellot, "who had been selected by government as a person whose labours might greatly improve the art of dyeing; made experiments on the subject, by dyeing woof of all colours, and even with dyes of all sorts, used either for durable or fading colours; he even sent to the different provinces for such as are not employed at Paris; and, finally, he collected most of the different substances which he conceived might be employed in the art, and tried a very great number of them, investigating their good or bad qualities, without paying any regard to the prejudices of the dyers.
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174. With a view to know what colours were, and what were not durable and fading, he exposed to the sun and air, for twelve days, some patterns of all colours, which had been dyed in his own house with known compositions. It appears, that this time was sufficient for a trial of them; for the durable colours are not at all, or but little injured, while the fading ones are almost entirely obliterated; so that, after twelve days exposure to the heat of the sun, and the dampness of the night air in summer, there can be no doubt as to the class in which each colour should be placed.

175. But there still remains a difficulty, which was that the three colours had not been exposed to the air precisely at the same time and in the same season, some might have had more sun, and, consequently, might have suffered a greater change in the twelve days, than others exposed in more cloudy weather, or when the days were shorter. But he discovered a remedy for this inconvenience, which removed all difficulty and doubt as to the accuracy of the experiments; he chose one of the worst colours, that is, one on which the sun had produced the greatest effect in twelve days. This colour served as a standard in the experiments; and whenever he exposed patterns to the air, he always exposed a piece of the stuff along with them; so that he did not calculate by the number of days, but by the colour of his standard, always keeping the pattern exposed, till it had lost as much as that would have done by twelve days exposure in summer. As he always noted the day on which he exposed his patterns, he was led to observe, that in winter it was only necessary to leave them four or five days longer exposed to the air than in summer. By pursuing this method, he removed all doubt as to the accuracy of his experiments. In this trial, by exposure to the air and to the rays of the sun, he had a still farther object, which was, to find the proper proof for each colour. What is called proof, is the trial of a stuff, with a view to discover whether its dye be permanent or not: a pattern is boiled with alum, tartar, soap, vinegar, lemon juice, &c. and its quality is judged of by the effect these substances produce. The proofs used in 1733 were so insufficient, that they did not even assist Mr Du Fay in discovering more certain ones; they even destroyed some good colours, while they produced very little effect upon the bad; so that he was obliged to fix upon several, each of which serves for a great number of colours. The following is a short description of the method he pursued in order to discover them.

176. After having observed the effect of air on each colour, whether good or bad, he tried the same stuff with different furs, and stopped when he found one which produced the same effect with the air; then noting the weight of the ingredients, the quantity of the water, and the length of the trial, he was sure to be able to produce on a colour an effect equal to that which the air would have produced, supposing it had been dyed in the same way with his; that is, according to the methods employed by the dyers of true and false colours. Having thus examined all the colours, and all the ingredients employed in dyeing, he found out a method, which may be considered as accurate, of distinguishing the good or bad qualities of each colour, by making, by means of the proof, a sort of analysis of the materials which composed it. We cannot, without injustice, refuse to acknowledge, that the means Mr Du Fay employed, in the discovery of these proofs, or tests for colour, are ingenious; for the trial by air and sun cannot be made on those, where it is necessary to judge immediately, whether a stuff exposed to sale, at a fair or elsewhere, as if a true dye, be really so or not.

177. The proofs mentioned in the new regulations, made in consequence of Mr Du Fay's memoirs, discharges in a few minutes as much of a colour, where it is not dyed of a durable colour, as would be lost by twelve or fifteen days exposure to the air. But, as general rules for such trials must be liable to many exceptions, which either cannot be foreseen, or, though foreseen, cannot be particularized, without the risk of occasional disputes, it follows, that these rules, considered perhaps as too general, are also too severe in many cases wherein light colours require salts, or quantities of salts, which shall be less active than those necessary for deep or loaded colours, which may allow a considerable portion of their colouring matter to be carried off by a proof, without shewing a very visible alteration. It would, therefore, have been very necessary to prescribe a proof for almost every shade, which, from their infinite variety, would be impossible. Thus the air and the sun will always be the true test; and every colour which is not changed by them in a certain length of time, or which, by exposure, acquires what the dyers call a body, ought to be considered as a standing colour, even though it should be considerably changed by the proofs. Of this we have an example in scarlet; as soap almost entirely discharges this colour, it has been submitted to the trial by alum; and when it has been dyed with cochineal alone, without any mixture of other ingredients, it ought to assume a purple colour in a boiling solution of alum. If scarlet be exposed to the sun, it loses some of its brightness, and becomes deeper; but this deep shade is not similar to that imparted by alum. Proofs, then, in certain cases, cannot be substituted for the action of the air and sun, at least so far as respects similarity of effect.

178. By means of Brazil wood, which, like almost all the other woods loaded with colour, gives a fading dye. I prepared a red which was much finer than the madder reds, and as bright as those made with kermes; this red remained exposed to the air for the two last months of the year 1740, which were very rainy, and for the two first of 1741; notwithstanding the rain and bad weather, it stood, upon account of its peculiar preparation, which will be mentioned in the proper place, and was so far from losing, that it acquired body. Yet the same red which is so durable in the air, does not resist the trial by tartar. Would it then be proper to proscribe this colour, because that salt discharges it, or are the stuffs we employ for clothing intended to be boiled with tartar, alum, or soap? I do not, however, mean to disapprove of the trial by proofs, they are useful because they are ready, but there are cases in which they ought not to serve as a ground for pronouncing a sentence of confiscation, especially when they cannot show that a colour which should have been dyed for materials for durable colours, has been dyed with those of a fading nature.

179. Upon the whole, then, it appears that the only sure test we can employ, is direct exposure to air and light, for those stuffs which are not to be leyed; and washing with alkalies and soap for such as are to be leyed. And it is the only sure test of the goodness of these substances. In order to try the colours of silk, it is generally thought sufficient to expose them to heat in acetic acid, or lemon juice; and they are considered as good and permanent colours if they stand this test. And, indeed, when the woods...
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SECTION III.

Of Stuffs.

CHAP. I. Of the Nature of Stuffs in general.

180. Though a knowledge of the structure of organized bodies, and of the proportions in which their ultimate principles are combined together, can seldom, without the aid of experiment, afford much information respecting their relations with other substances, we cannot doubt that an intimate acquaintance with their mechanical form and composition will throw some light on these relations, and point out the best means of investigating such as cannot be discovered by analogy alone. We shall therefore endeavour to ascertain the mechanical and chemical constitution of the various kinds of stuffs, as a knowledge of these may assist us in discovering the circumstances upon which their attractions for colouring matters depend.

181. The stuffs usually submitted to the operation of dyeing, are wool, silk, cotton, and flax. The two first are of animal origin; the two last are vegetable products. These substances disagree with one another in chemical composition, and are characterised by those differences of constitution which usually distinguish the productions of the animal and vegetable kingdom. Animal substances differ from vegetable products, by containing a considerable quantity of nitrogen, an element which exists but sparingly in vegetables; and also a larger proportion of hydrogen. This difference of chemical constitution is rendered very obvious, when animal and vegetable products are subjected to distillation. The former yield a large quantity of ammonia, the latter seldom give out that substance, but frequently an acid. The former yield much oil, while, in many cases, vegetable products do not yield the smallest quantity. Here, again, animal substances, during their combustion, afford a bright flame, though of short continuance, as it is soon extinguished by the charcoal which is formed; they, at the same time, emit a very pungent odour, owing to the extrication of ammonia, and of the empyreumatic oil, which makes its escape without being consumed. Animal substances are very liable to putrefaction, and during the advancement of the process, evolve much ammonia; while vegetable products suffer more slowly the vinous or acetous fermentation.

182. As substances are most readily decomposed when the elements which enter into their composition are numerous, animal matters are more liable than vegetables to be destroyed by the different agents to which they are exposed. The number of elementary principles which they contain, enlarges in an equal degree the sphere of their chemical affinity; and hence they are also more disposed to combine with colouring matters. Thus the pure alkalies quickly destroy animal substances, because they combine with them, and lose their causticity, while they have little or no effect on vegetables. The nitric and sulphuric acids also act with considerable energy on animal substances; the former decomposes them, extricates the nitrogen, separates the fatty matter, and forms carbonic and oxalic acids; the latter extricates the hydrogen, a small portion of nitrogen, and leaves a carbonaceous residuum.

183. Silk, though an animal product, partakes a good deal of a vegetable nature. It is less disposed to combine with colouring matters than wool, and resists better the action of acids and alkalies. Cotton and flax withstand the action of acids and alkalies more powerfully than wool and silk, the former being destroyed with difficulty even by the nitric acid. These differences are chiefly owing to differences in chemical constitution; but they may be partly ascribed to differences in the conformation of their fibres, and organic structure.

CHAP. II. Of Wool.

184. The different kinds of wool vary chiefly in the general length and delicacy of the fibre. Its qualities depend partly upon the breed of the sheep from which the wool is taken, and partly upon the parts of the animal to which it adhered. The finest wool is brought from Spain; though Berthollet affirms, on the authority of D'Aubenton, that it might be produced in France of a quality equally good, by a little attention on the part of the shepherd. Attempts have been made of late to introduce the Spanish breed of sheep into this country, with the view of rendering us independent of a supply of wool from abroad; but it is probable that change of climate may affect the habits of the animal, and produce alterations on the fleece. It is well known that the nature of the pasture has a considerable effect on the quality of wool. The manufacturer should be able to judge with accuracy respecting the fineness of it; and, as simple inspection is insufficient for the purpose, the fibres should be closely examined with a microscope, and compared with those of other wools, selected as standards.

185. In the raw state, wool is covered by a sort of unctuous matter called yolk, or suint, which preserves it from the attacks of moths, and, on that account, ought not to be prematurely removed. This substance has been examined by Vaquelin, and appears to be a kind of animal soap, having potash for its basis, together with a quantity of fatty matter, and a portion of lime in combination with the carbonic, acetic, and muriatic acids. The wool of healthy sheep is always more abundantly covered with yolk than that of the sickly and diseased.

186. Before wool is submitted to the operation of dyeing, the yolk is removed by scouring or maceration for about a quarter of an hour in water, mixed with a fourth part of salted urine, and heated so as the hand can just bear the temperature. After being duly stirred in this mixture, it is taken out and drained; it is then carried to a stream of running water, and moved about till the greasy matter appears to be completely separated, and ceases to render the water turbid. M. Vaquelin recommends, that the wool, after being cleansed as effectually as possible with pure water, should be soaked for a few hours in a tepid solution of soap, one pound of soap being employed for every twenty pounds of wool to be scoured. M. Roard is of opinion that one pound of Flanders soap, employed in this manner, is sufficient for thirty pounds of wool; he recommends, however, that the water should be heated to 60° of Reaumur, (147° of Fahrenheit.) He affirms
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187. The wool is dyed in the fleece, or before being spun, chiefly when it is to be manufactured into cloths of mixed colours, and it is dyed after being spun when it is to be made into worsteds. But it is generally dyed after it has been manufactured into cloth.

When wool is dyed in the fleece, its filaments being separate, are in a situation for absorbing a greater proportion of colouring matters than when it is spun, and still more when it is in the form of cloth; but different woollen stuffs vary considerably in this respect, according to their fineness and closeness of texture. These circumstances taken in consideration with the different qualities of dyeing ingredients, prevent us from relying with implicit confidence on the processes usually recommended.

188. After wool has been spun and wove, it is subjected to the operations of felting and fulling. According to the observations of M. Monge, the fibres of wool consist either of a great number of small laminae overlapping one another from the root to the extremity, or of a series of annular concretions, like the horns of animals, gradually decreasing in diameter towards the point. From this structure of the woolly fibre, a hair held by one hand by the root, and drawn between the thumb and finger of the other hand, scarcely any friction or resistance is perceived; but if it be drawn in like manner, in a contrary direction, a tremulous motion is distinctly felt, accompanied with a sensible grating noise. By this conformation of the fibre, a hair when it is pressed must suffer greater resistance, when it slides in the direction of the point, than in that of the root; and to obviate the inconvenience which this would occasion in spinning, wool is covered with some unctuous matter, which in some measure smooths its asperities, and thus facilitates that operation. After the wool is manufactured, the oil being no longer useful, is removed both for the sake of cleanliness, and to enable the stuff to absorb more effectually the dye. The cloth is therefore taken to the fulling mill, where it is beaten with large beaters, in a trough of water, containing diffused through it a quantity of fullers earth. The earthy matter uniting with the oil, forms a kind of soap, which is carried off by the constant action of the machinery, and the effusion of fresh portions of water.

See Wool.

CHAP. III. Of Silk.

189. Silk is of animal origin, and consists of the fine threads with which the bombyx mori, a moth belonging to Linnaeus's third order of insects, envelopes itself before it emerges in the perfect state. Silk is naturally covered with a gummy or glutinous substance, to which it owes its stiffness and elasticity; it is also frequently tinged with a yellowish colouring matter. The purposes for which silk is usually employed, require that it should be freed from both these matters; and this is commonly done by means of soap. Besides the gummy and colouring matters, there is also, according to Board, a substance to be removed, which has a considerable resemblance to wax. He states, that the gummy matter, which is soluble in water, usually amounts to about 24 per cent, and the colouring matter to about 1-57th, or 1-60th part of the silk; the wax seldom exceeds the 1-100th part of the silk, and is frequently less than half that quantity. All these substances are removed by scouring with soap; but this operation must be slightly modified, according to the purposes for which the silk is intended: it ought not to be so complete for silks which are to be dyed, as for those which are to be white, and a difference ought to be observed in the former experiments according to the colour to be given. For common colours, it is generally thought sufficient to boil the silk for three or four hours, in a solution of twenty pounds of soap for each hundred of silk, taking care to fill up the kettle from time to time, to replace the water carried off by evaporation. The quantity of soap is increased for those silks which are to be dyed blue; and still more for those which are to be scarlet, cherry-colour, &c. these colours requiring a brighter ground for their display than such as are of a more delicate hue.

190. Silk which is to remain white commonly undergoes three operations. In the first of these, which is intended to remove the gummy matter, it is kept in a solution of thirty pounds of soap to a hundred of silk, the solution being very hot, but not boiling. When it has been immersed a sufficient length of time for the removal of the gum, which is known by the whiteness it acquires, it is taken out and wrung. In the second operation, the silk is put into bags of cloth, and boiled in a weaker solution of soap for about an hour and a half, taking care to keep the bags constantly stirred to prevent those which touch the bottom receiving too much heat. The third operation is intended to soften the white, and render it more pleasing, by giving it a slight shade of some delicate colour. For this purpose, a solution of silk is employed, the proper strength of which is determined by its mode of frothing; this is slightly tinged with a colour of the shade to be given, and the silk is then moved about in it until it acquires the desired hue. At Lyons, where silk is scourcd of a beautiful white, no soap is used in the third operation; but after the second, the silks are washed, fumigated with sulphur, and azured with river water.

191. Board thinks, that instead of employing the Board's soap at different times, it is more advantageous to employ the whole quantity to be used at once, and by that means shorten the boiling to an hour, or a little more; the silk is thus left with more of its natural softness and lustre, as well as stronger and more elastic. He recommends, indeed, that when it is to be dyed of a crimson, or any other colour which would not be affected by the yellowish tinge of the silk in its raw state, the latter ought not to be completely removed; because, when this is done, the dyed colour possesses less brilliancy than it would otherwise have.

192. As soap seems to impair the lustre of silk, the Academy of Sciences, in 1761, proposed, as the subject of a prize dissertation, to find a method of scouring it without soap; and the prize was adjudged to M. Rigaud of St Quentin, who proposed substituting for soap a solution of soda, or carbonate of soda, so much diluted as not to affect the texture of the silk. But some inconvenience must have attended the practice of this method, as it is not adopted, though generally known, and easy of execution. Board, indeed, affirms, that the gummy matter of the silk is less effectually removed by soda than by soap.

193. The Abbé Collomb has given an account of a Collomb's method of scouring silk by the action of water alone, which deserves attention. Having boiled silk for about
Of Stuff. If three hours in common water, he found that its weight was diminished about one-eighth; and upon repeating the operation, the loss of weight amounted nearly to one-fourth. The silk still retained a yellowish or chamois colour; and though it did not possess a sufficiently bright ground for the more brilliant colours, it answered very well for those which were not affected by the tinge it retained. It took a finer and more glossy black, for example, than if it had been scoured in the usual way with soap.

194. When silk is intended for the manufacture of dyes and gauzes, its natural elasticity and stiffness should be preserved as much as possible; but as the methods usually employed for removing the colouring matter, also deprived of the gum, it became a desideratum to whiten silk without affecting its elasticity. M. Beaume discovered a method of doing this by means of muriatic acid and alcohol. The process, however, is said to be liable to accidents; and, notwithstanding the advantages which it appears to present, it is scarcely employed.

195. Before silk can be dyed, it must be prepared with alum, as without this operation the greatest part of the colours applied would possess neither beauty nor fixity. This preparation consists in mixing, in a tan or vat, about forty or fifty pails of water, with an equal number of pounds of Roman alum, which has been previously dissolved in warm water; the solution being well stirred during the mixture, to prevent the alum returning to the crystallized state. The silk, after being well washed and wrung, to free it completely from any soap which may have adhered to it, is immersed in the alum liquor, where it is allowed to remain for eight or nine hours, after which it is wrung out, and washed in a stream of pure water. The above quantity of liquor is sufficient for 150 lbs. of silk, and with the addition of a little more alum when the solution begins to grow weak, may be used for a fresh portion, as before: this addition may be repeated until the liquor acquires a disagreeable smell, and it may then be employed in the preparation of stuffs intended for dark colours, till all its strength is exhausted. The preparation must be performed in the cold, because the liquor, when it is employed hot, impairs the lustre of the silk. See Silk.

CHAPTER IV. Of Cotton.

Different kinds of cotton. 196. Cotton is the downy substance contained in the pods of a genus of plants denominated *Gossypium*, of which Linnaeus describes five species, the *herbaceum*, *arboresum*, *hirsutum*, *religiosum*, and *barbadense*. The qualities of the cotton vary in these different species, and depend not less upon the climate than upon the plant itself. Great varieties of the gossypium occur in the American islands; but, according to Mr Bennett, the inhabitants have hitherto neglected to choose the most valuable species, and have thus lost much of the benefit which they might have derived from this valuable article of commerce.

External characters. 197. Cottons differ principally in the length of the filaments, their fineness, strength, and colour. The structure of the fibre has not been well ascertained. Lewenhoeck, who examined it with a microscope, affirms, that it has two sharp sides; a convolution which serves to explain the irritating property of cotton, when it is employed in dressing wounds and ulcers instead of lint. Dr Bancroft seems to ascribe the disposition which cotton has of imbibing colours more readily than linen to this mechanical structure; and yet, with some degree of inconsistency, he has bestowed considerable pains to controvert a similar opinion of M. le Prieur d'Apligny. "This author," says he, "endeavoured to explain the cause why colours are less durable when dyed in silk, cotton, and linen, than in wool, by supposing that the pores of the three first of these substances were smaller than those of wool; and that, therefore, colouring particles could not enter into them so easily and freely as into those of wool. But the very reverse of this supposition seems true, there being little difficulty in making silk, cotton, or linen, imbibe colours, even when topically applied cold, without any artificial dilatation of their pores, which is necessary in the dyeing of wool. The real difficulty, therefore, is not in making them imbibe, but in making them retain the colouring particles when imbied; because being admitted so readily into their undilated pores, they cannot be afterwards compressed and held therein by any contraction of these pores, as is done in those of wool. We know that it requires twice as much cochineal to produce a crimson on silk as on wool, which is a proof that it can take up a greater quantity, and consequently that its pores are at least sufficiently large and accessible; we know also, that unbleached cotton is always preferred for dyeing the Turkey red, it being found to retain the colour most permanently; doubtless, because its pores or interstices are less open before than after the operation of bleaching. This is also the case of raw or unscoured silk, which, as the ingenious Mr Henry of Manchester observes, is more easily and permanently dyed than that which has passed the above described process of whitening and scouring, and, indeed, the openness of the pores of cotton and linen, and their consequent readiness to imbibe both colouring particles, and the earthy or metallic bases employed to fix most of them, are circumstances upon which the art of calico-printing is in a great degree founded."—The sentiments of Dr Bancroft respecting the cause of the union and durability of the colouring matter with the stuff, as they are expressed in the passage we have just quoted, seem to agree completely with the exploded notions of Heliot on the same subject. Both refer the operations of dyeing to the dilatation of the pores of the stuff; to the deposition in them of particles of foreign matter; and to the retention of these particles in their new situation, by the subsequent contraction of the pores. No notice whatever is taken of the influence of chemical affinity, but the whole process is described as depending upon mechanical principles. This is the more surprising, as Dr Bancroft, in other parts of his excellent treatise On the Philosophy of Permanent Colours, has distinctly referred the combination of the colouring matter, with the stuff to which it is applied, to the influence of chemical attraction.

198. In order to dispose cotton to receive the dye, it must undergo the operation of scouring. It is sometimes boiled in sour water, but more frequently in alkaline lea. The boiling is carried on for two hours, after which it is wrung out; it is afterwards well rinsed in a stream of water, and then dried. Cotton stuffs are prepared for calico printing by soaking them in water mixed with at most 1-50th of sulphuric acid, washing them afterwards in a stream of water, and then drying them. Berthollet observed, that the acid used in this operation, combined with a quantity of calcareous earth and iron, which would injure the colours.

199. To prepare cotton for being dyed, it must also be
Exposed to the operations of aluming and galling. In the preparation with alum, about four ounces of it are required to each pound of stuff. Some add a solution of soda, in the proportion of 1-10th of the alum; others, a small quantity of tartar and arsenic. The cotton is thoroughly impregnated with this solution, by working it in small quantities; it is then put altogether into a vessel, and what remains of the liquor is poured over it. In this state, it is left for twenty-four hours, and then carried to a stream of water, where it is allowed to remain an hour and a half; or two hours, to remove the superfluous alum; after which it is washed. In the operation of galling, different quantities of galls are employed, according to the quantity of astringents, and the effect desired. The galls powdered are boiled for about two hours, in a quantity of water proportioned to that of the cotton to be galled. The liquor is then suffered to cool to a temperature which the hand can bear, after which the stuff is divided into a number of equal parts, that it may be wrought pound by pound, and what remains after the operation, is poured upon the whole together, as in the process of aluming, already described. It is then left for twenty-four hours, especially when intended to be madderred for black; but for other colours, twelve or fifteen hours are sufficient. When stuffs are galled, which have already received a colour, the operation must be performed in the cold, that the colour may not be injured. See Cotton.

**Section IV.**

**Of Mordants.**

201. The colouring particles seldom have such a decided affinity for the substances usually submitted to the operations of dying, as to form with them a permanent union; it frequently happens, indeed, that the same solvent which deposits the colouring matter on the stuff, will, with equal facility, re-dissolve and erase it. We have already stated, however, that the colouring matters possess very strong attractions for earths and metallic oxides, particularly for the earth of alumine and the oxides of iron; and as these bodies also unite readily with the fibres of which stuffs are usually fabricated, a triple compound may thus be formed, consisting of the stuff, the colouring matter, and the chemical agent having an attraction for both. The substances which serve as a bond of union between the colouring matter and the stuff, are called mordants, a term applied to them from the mechanical action which they were supposed to exert upon the latter, to prepare it for the reception of the dye. As the theory concerning the action of mordants, which first suggested the term, is now completely exploded, Mr. Henry has proposed to substitute in place of mordant, the word basis.

We shall sometimes employ the one term, and sometimes the other.

202. The word mordant is also applied in a more extensive sense, not only to denote those substances which promote the union of the colouring matter with the cloth, and render that union permanent, but all those agents which affect, in any respect, the colouring matter in its new state of combination. Dr. Bancroft has endeavored to apply the term alterants to this class of bodies, their object being not so much to fix, as to vary and modify the shades of adjective colouring matters.

203. The nature of mordants deserves to be investigated with the utmost attention, for though almost all the substances included under this appellation have been discovered by accident, an accurate analysis of their action must tend greatly to improve the principles of dyeing, and give something like a scientific form to its processes.

204. A mordant is not always a simple agent; new combinations are sometimes formed by the ingredients of which it is composed, so that the substances employed are not the immediate agents, but the compounds to which they give rise. The substances which compose a mordant, are sometimes incapable," says Berthollet, "of decomposing each other solely by their own attractions; but the attraction of the stuff for one of their constituent parts brings about a decomposition and new combinations, and sometimes this effect is not produced or completed without the aid of the attraction of the colouring particles. This appears to be the case in the mixture of alum and tartar, one of the most common mordants employed in the dyeing of wool."

205. "I dissolve," continues he, "equal weights of alum and tartar; the latter salt, by this mixture, acquired a greater degree of solubility than it naturally possesses, but by evaporation and a second crystallization, the alum and the tartar were separated, so that they had not decomposed each other. I boiled for an hour half an ounce of alum with an ounce of wool, a precipitate was formed, which I washed carefully; it consisted chiefly of small filaments of wool incrusted with earth; to this I added sulphuric acid, and evaporated to dryness, dissolved it, and obtained crystals of alum. Some carbonaceous particles separated from it. I evaporated the liquor in which the wool had been boiled, but obtained from it only a few grains of alum; the remainder would not crystallize. I re-dissolved it, and precipitated the alumine by an alkali: the precipitate was a slate colour; it grew black upon a red hot coal, and emitted alkali vapours."

"By this experiment," says he, "we see that the wool had decomposed the alum; that a part of the alumine had combined with its most detached filaments, which were least retained by the force of aggregation; that a part of its animal substance had been dissolved and precipitated by the alkali, from the triple combination which it had formed. I made the same experiment with half an ounce of alum, and two drams of tartar; no precipitation took place. I obtained by evaporation a small portion of the tartar, and some very irregular crystals of alum, the rest would not crystallize; this I diluted with water precipitated by potash, and obtained by evaporation a salt which burned like tartar."

He afterwards infers from the whole, "that the wool had begun a decomposition of the alum, that it had united with a part of the alumine, and that even the part of alum which retained its alumine had dissolved some of the animal matter; that the tartar and alum, which
cannot decompose each other solely by their own attractions, become capable of acting on each other when their attractions are assisted by that of wool; that the tartar appears principally useful for moderating the too powerful action of the alum upon the wool, whereby it is injured, for tartar is not used in the alumining of silk and thread, which have less action on the alum than wool has.*

206. Berthollet has shown the attraction of alum for animal substances by an experiment not less decisive: having mixed a solution of glue with a solution of alum, he precipitated the earthy base by an alkali, when the alumine fell down, and carried along with it a portion of combined glue. The decomposition of alum is not so readily produced by vegetable substances, though it is partially effected by the assistance of the astringent principle. When a stuff is impregnated with the latter, and placed, after it has been allowed to dry, in a solution of alum, a combination is established between the alumine and the tamin.

207. The attraction of alumine for the greater number of colouring substances may also be shewn by direct experiment. If a solution of colouring matter be mixed with a solution of alum generally takes place, consisting of the colouring particles combined with alumine. The precipitate is known in the arts under the name of lac or lake, and is more readily formed when an alkali is added to detach the acid, and leave the alumine at greater liberty to unite with the colouring matter. An excess of alkali ought not to be added, however, because alkalis dissolve the greater number of the lakes. M. Thenard has shewn that alumine may even be intimately mixed with several metallic colouring matters, as prussiate of iron, oxide of cobalt, &c.

208. The metallic oxides have also a strong attraction for colouring matters, and when they are presented to the latter in combination with an acid, they frequently quit the solvent, and are precipitated like the alumine in combination with the colouring matter. This class of bodies has also the property of combining with animal substances, and of thus serving as a bond of union between these and colouring particles. But not only have the oxides a strong attraction for colouring particles, and animal matters, but their solutions in acids have the properties which render them less fit to be employed as mordants; and indeed it is generally in this state that they are used in dyeing.

209. In order that a substance may be fit for being employed as a mordant, it is not always sufficient that it should possess an affinity to the colouring principle and the stuff; it must also be perfectly white, otherwise its colour mixing with that of the colouring principle, would produce an intermediate or mixed colour. In some cases, indeed, this may be an advantage, and a substance may be employed both as a colouring matter, and a mordant. Thus the oxide of iron, which, if it were employed alone, would produce a tannic or buff colour, communicates to cotton a violet with madder red; and in like manner, the oxide of tin not only fixes, but greatly exalts several colouring matters. Mordants ought also to be little liable to change, by the action of air and water, the two agents to which dyed stuffs are most frequently exposed. The metallic oxides, from their disposition to attract additional portions of oxygen from the atmosphere, and on that account to suffer changes themselves, as well as to affect the shades of colouring matters, are less valuable as mordants than they would otherwise be.

210. Neutral salts, particularly nitre and muriate of soda, (common salt,) act as mordants, and modify colours; but the nature of their action has been little attended to, and is imperfectly understood. Berthollet found that the muriate of soda was contained in the precipitates produced from some kinds of colouring matter, and that these precipitates contained a considerable degree of solubility; he conceives that a small part of the salt attaches itself to the colouring principle which renders the latter more perfect, but as the changes to which they give rise may be produced by the addition of a small quantity of lime, it is probable that they suffer a partial decomposition, and that when they are used in dyeing, a little of the calcearose base enters into combination with the colouring particles and the stuff.

211. The two mordants most extensively employed at present, are salts of alumine and tin. The former is prepared, according to Berthollet, by dissolving in eight pounds of hot water, three pounds of alum, and one pound of acetate of lead, (sugar of lead,) to which two ounces of potash, and afterwards two ounces of powdered chalk, are added. The alum is decomposed by the acetate of lead, because the oxide of lead combines with the sulphuric acid of the alum, and forms an insoluble compound, which is therefore precipitated; while the alumine is attracted by the disengaged acetic acid, and forms the acetate of alumine. The chalk and the potash are added to neutralize the excess of the sulphuric acid, and to assist the operation of the acetic acid. The substitution of the acetic acid for the decomposition of the alumine, is attended with several advantages. The acetate of alumine being much more soluble than alum, the same quantity of solvent will hold suspended a greater quantity of the former than the latter, and thus present the mordant in a more concentrated state to the stuff; while, on account of its great solubility, it will not be apt to crystallize when mixed with starch or gum, to prepare it for being applied to the block, in topical dyeing. The alumine is also retained less powerfully

* These experiments of Berthollet, which seemed to establish the fact, that a powerful affinity subsists been alumine and the fibres of wool, have been questioned, or rather their accuracy has been distinctly denied by Thenard and Baird. By a series of experiments, of which they have given a minute statement, in a memoir read at the Physical and Mathematical class of the French National Institute, they ascertained, that alum and tartar do not decompose each other when dissolved in water and boiled with wool; that, in this boiling, the wool combines with the alum without decomposing it in any degree, and also with the tartar; and that equal parts of alum and tartar would dissolve in two fifths less of water than would be required to dissolve them separately. They found that wool, as it is commonly cleansed for being dyed, was not deprived of the carbonate of lime naturally combined with it; and that the wool being boiled the usual time, with one fourth of its weight of alum, and one sixteenth of its weight of tartar, produced a copious white sediment, which, being collected, washed, and examined, was found to consist chiefly of a sulphate of lime, and a saturated sulphate of alumine; that when wool had been properly cleansed, and freed from the carbonate of lime, no sulphate was obtained; and that, when in this state, it was boiled in pure water, with the proportions just mentioned of alum and tartar, the residuum of the bath after evaporation was found to consist of alum, cream of tartar, and a compound difficulty crystallizable, composed of tartaric of potash and animal matter. The wool itself softened, by repeated washings, alum and a small quantity of cream of tartar, besides a very small combination of tartaric acid, alum, and animal matter. The results obtained by these chemists have led them to conclude, that, in the process of alumining animal substances, the alum combines with them entire without suffering decomposition. They have also drawn a similar conclusion with respect to stuffs of vegetable origin, viz. cotton and linen.
DYING.

Dr Bancroft mentions, that an acetate of alumine may be prepared more cheaply, by dissolving white lead, not adulterated by carbonate of lime, in strong vinegar, and then adding to the solution a proper proportion of alum. He found also, that licharge, dissolved in vinegar, instead of white lead, was equally useful for decomposing alum. The pyrroligneous acid, as it was formerly termed, may be substituted very advantageously for vinegar, to dissolve the oxide or carbonate of lead; and the acetate of lead thus formed, united with the empirumatic oil which comes over along with the acid, may be employed instead of the common acetate of lead, for decomposing alum. It has also been recently discovered, that lime, dissolved in the pyrroligneous, or other acetic acid, may be employed with still greater advantage for decomposing alum, and forming the acetate of alumine. See Philosophy of Permanent Colours, vol. i. p. 306.

Dr Bancroft's experiments with different salts of tin, showed the liberty of giving an abstract of the results of his experiments. Cochineal, with a solution of tin by nitric acid, only dyed a beautiful crimson or rose colour; and with a solution of that metal by a mixture of tartar and muriatic acid, a beautiful scarlet. The same colouring matter produced, with tin dissolved by a mixture of muriatic and pyrroligneous acid, a dark crimson. Cochineal, with tin calcined by the long continued action of sulphuric acid, dyed a salmon colour; and with a recent solution of tin, it produced a reddish salmon colour, inclining a little to crimson. Tin dissolved by the pure acid of tartar, dyed with cochineal, on cloth, a very lively and beautiful scarlet, inclining a little to orange. A similar colour was produced by water saturated with cream of tartar, in which granulated tin had been kept six weeks. Tin may be readily dissolved by pure citric acid, and more slowly by lemon juice. The solution, freshly prepared, dyed with cochineal a very beautiful scarlet. If it were not too costly, says Dr Bancroft, this solution would deserve the preference of every other for dyeing that colour. Tin dissolved by the pyrroligneous acid, produced with cochineal a colour between scarlet and a rose colour. Phosphoric acid produced a permanently transparent and colourless solution of tin, which, with cochineal, dyed a bright yellowish scarlet. Tin dissolved by fluoric acid, produced with cochineal a very bright scarlet. Tin dissolved by a direct mixture of pure nitric and muriatic acids, in equal proportions, the former of the specific gravity of 1.17, and the latter of 1.17, produced with cochineal, and the common allowance of tartar, a very bright lively scarlet. A similar solution, with an addition of sulphuric acid equal to one-fourth of the nitric, yielded only a salmon colour; the oxide of tin having been precipitated from the common dyers' spirit by soda, and afterwards dissolved by sulphuric acid, was incapable of dyeing, with cochineal, any colour more elevated than orange.

All these experiments show the advantage of using tin as a mordant, or as a substitute to it. A solution of tin is cheap and easy of preparation, and is capable of being employed at all times, without affecting the dye, or the colouring matter. It may, therefore, be recommended as a substitute to the expensive and troublesome preparation of mordants, and the use of it will be found by practical experiment to answer every purpose.

216. Dr Bancroft ascertained, that a muriate of tin, Muric-sulphate of tin, containing only half the quantity of the metal which plate of tin, the acid is capable of dissolving, operated even more successfully in dyeing scarlet, than an equal quantity containing twice as much tin; and he therefore concludes, that nearly one half the tin, which the scarlet dyers commonly dissolve with aquafortis, and a little sea salt, is wastefully employed; a fact, he adds, which, considering the increased price of tin, may, by proper attention, produce a saving of very considerable importance. He found also, that the same quantity of tin dissolved in muriatic acid, combined with about one-fourth of its weight of oil of vitriol, forming what he calls a murio-sulphate of tin, produced excellent ef-

Of Mordants.

Composi-
tion, spirit, or solution of tin.
factors as a mordant. The proportions which he found to answer the purpose best, were about 14 ounces of tin in a mixture of two pounds of oil of vitriol (of the usual strength), with about three pounds of muriatic acid of the specific gravity of 1.17. The muriatic acid should be first poured upon a large quantity of granulated tin, in a capacious glass receiver, and the oil of vitriol afterwards added slowly; and these acids being mixed, should be left for a quarter of an hour to saturate themselves with tin, which they will do in a moment, according to the temperature of the atmosphere, without any artificial heat. The muriato-sulphate of tin, prepared according to the above directions, is perfectly transparent and colourless, and will probably remain so for many years. It will produce fully twice as much effect as the dyers' spirit, or nitro-muriatic solution of tin, at less than a third of the expense. It has also the property of exalting the colours of all the adhesive dyes, says Dr Bancroft, more than the dyers' spirit, and fully as much as the tartrate of tin, without changing the natural crimson of cochineal towards the yellowish hue; and therefore he concludes, after having made a great number of experiments with it, "I think myself warranted in strongly recommending the muriato-sulphate of tin, for dyeing the compound scarlet colour from the cochineal and crimson, and queerziton yellow."

217. Some chemists pretend that the muriate of tin answers the purposes of a mordant most efficaciously when the metal is most highly oxidized; but the experiments of Dr Bancroft, and the results obtained by the writer of this article, lead to the very opposite conclusion. The experience of practical dyers is also at variance with that opinion; for it is well known, that when new the muriate of tin has been long kept, and thus had time to absorb more oxygen, it acts less powerfully in fixing and exalting colours. Constant observation teaches them, that a less lively and agreeable colour is obtained when the solution is made with rapidity, and the disengagement of much vapour, than when it is conducted slowly; doubtless, because in the former case the metal is more highly oxidized. On this account, fresh solutions made with ordinary caution, are preferable to old ones, however carefully prepared.

218. The tin employed in the preparation of the mordants, which have for their bases the oxides of that metal, should be of the utmost purity; common tin being frequently adulterated with copper and lead, each of which is prejudicial to the colour. Malacca, and good English tin, are reckoned the best; though even the latter generally contains a little copper in combination with it. The presence of iron and copper may easily be detected, by pouring a little prussiate of lime into the solution: the precipitate is blue if iron be present, and of a bronze colour if it contains copper.

219. The muriatic acid should also be the purest state in which it can be procured. When it is contaminated with foreign matter, it is perfectly impure and colourless; but it is frequently of a light yellowish appearance, owing chiefly, it is supposed, to the presence of a small quantity of iron derived from the sea-salt, with which procuring the acid. It may be obtained pure, by subjecting it to a second distillation, from a retort connected with a range of Wolfle's bottles, a little muriate of soda having been put with it into the retort, and a gentle heat applied.

220. Chapital has recommended a method of forming the muriate of tin, by causing the vapour of muriatic acid, as it is disengaged from the muriate of soda, to pass through a succession of large receivers, containing granulated tin, with a little water, to absorb the acid. The heat produced by the absorption of the vapour is sufficient to promote a solution of the metal, without the expense of fuel. If the receivers be constructed and adapted to each other, upon the principles of Wolfle's apparatus, the process may, in this way, be conducted with a considerable saving of expense, as no loss will be sustained by the evaporation of the acid, or of the tin in combination with it, which takes place to a considerable extent, according to the ordinary method of effecting the solution.

221. The salts which have already fallen under consideration, constitute the principal mordants used in dyeing, though several other substances are occasionally employed for the same purpose. M. D'Ambourney, of Rouen, has made much use of a solution of bismuth, which had formerly been proposed by M. Folie, of the same city. One part of bismuth is dissolved in four parts of nitric acid; the solution is afterwards introduced into a bath containing tartar, and into which is poured, at the same time, a solution of sea-salt. Perthollet has shewn, that in whatever way this mordant is prepared, there is always formed a precipitate by the addition of water, which renders the colouring matter of a brown colour. Chapital made use of it in dyeing cotton red, for which its author has proposed it; but it was not productive of a greater effect than water acidulated with nitric acid.

222. The oxide of arsenic is also employed as a mordant in dyeing. Vogler appears to have used with advantage a solution of this oxide with potash, in dyeing thread and cotton of a red colour. After dissolving the solution in two parts of water, he added to it a saturated solution of alum. The mixture is at first turbid and gelatinous; but it recovers its transparency, by gradually adding to it a solution of alum. Thread and cotton immersed for twelve hours in this mordant, on being washed and dried, assume, with madder, a very deep colour. The sulphures of arsenic, known by the names of orpiment, realgar, sandarach, yellow arsenic, red arsenic, i.e., are also used in dyeing, particularly in the preparation of indigo. The sulphuret of antimony may be substituted for that of arsenic; but it does not communicate to the colour the same brightness.

223. The corrosive sublimate is also used in dyeing. Wilson employed it in the composition of the aluminous mordant for printing linen, in the proportion of one-eighth of the sugar of lead. It appears, by the experiments of Vogler, that this salt renders the colour of madder darker and more durable.

224. The oxides of lead have been used as mordants, but they tarash the lustre of colours. Vogler obtained a beautiful black, by galloing thread and cotton impregnated with the salt of lead, putting them afterwards in a solution of sulphate of copper, and boiling them in a logwood bath.

225. Some metallic oxides have so strong an affinity for the substances to which they are applied, that they remain permanently fixed on them, and produce colours which are almost indestructible. In treating of the oxide of iron as a mordant in the composition of the colouring matter, we noticed the readiness with which it enters into combination with stuffs, and the easy method of communicating, by means of it, a buff colour to cotton. We have now to remark, that the same substance may also be used as a mordant, to produce, with different colouring principles, violet, prune, and lilac colours. This oxide...
likewise constitutes the basis of black colours; so that it may justly be regarded as one of the most useful substances employed in dyeing, whether in producing colours by itself, or in acting as a mordant to madder red, with tannin, or the astringent principle.

226. The mordant of iron is applied under different forms. Some manufacturers employ the sulphate without any addition; others compose it by dissolving iron in vinegar; some add it to a decoction of rice flour, while others mix it with urine, herring brine, &c. The longer the composition is kept, the better it becomes. At present, instead of the sulphuric, acetic, or other acids, is substituted, as we formerly observed, the pyrrogilous acid, which differs from the acetic by holding the metallic portion in a more permanent state.

227. Mordants are not procured from the earthy and metallic bodies alone; for, under certain circumstances, vegetable and animal substances serve as mordants for each other. Thus, in the complicated process for dyeing Adrianople red, the stuff is first impregnated with an animal substance; the astringent principle is then applied, and after this preparation, the cotton is presented to the alumino mordant. In this case, therefore, the mordant is a triple compound of oil, the astringent principle, and alumine. The astringent principle merits particular consideration, not merely on account of its extensive use as a mordant, but also as a colouring principle. The class of substances included under the head of astringent principles, is rather vaguely defined. Frequently some slight resemblance in taste only has been attended to, and under the name of astringents, alum, and many vegetables possessing very dissimilar properties, have been confounded together, both in medicine and the arts; and more frequently still, every substance which renders a solution of iron black, has been considered as astringent. It does not appear, however, that either the property of corrugating the animal fibre, or producing a dark precipitate with the salts of iron, is sufficiently distinctive of the substances to which the term astringent is usually applied. Many vegetable products, which are decidedly astringent to the taste, afford no black precipitate with the salts of iron; and on the other hand, several substances which yield a copious black precipitate with the salts of that metal, exhibit no traces of astringency. The substance from which the astringent principle is usually extracted, is an excrecence formed on the branches of the oak, and known by the name of gallnut; (See Chemistry; p. 61.) As this is almost the only substance employed to afford the astringent principle for the purposes of dyeing, we shall confine our observations respecting astringents chiefly to its properties.

228. There are different kinds of the gall-nut; some inclining to white, yellow, green, brown, or red; others are ash-coloured, or blackish. They also differ greatly in magnitude, and are either round or irregular, heavy or light, smooth or covered with protuberances. Those which are small, knotted, and heavy, are reckoned the best; they are known by the name of Aleppo galls, and come from Aleppo, Tripoli, and Smyrna. Galls are almost entirely soluble in water by long ebullitions; sixteen drachms afforded Neumann fourteen of extract; from the remaining two drachms alcohol extracted only four grains.

229. The decoction of galls precipitates the oxide of iron of a deep black colour, and forms the well-known substance ink. The solutions of mercury, mixed with an infusion of galls, assumes a brick colour, which soon becomes of a reddish grey. Copper is easily precipitated; the precipitate is at first green, but becomes of an ash grey, and acquires a reddish coppery tinge in drying. Zinc yields a dirty green precipitate. Cobalt forms a light blue precipitate, which quickly becomes of an ash grey.

230. If the astringent property was owing to some individual principle, which was always the same in the different vegetables in which it occurs, the precipitates obtained by their means from a solution of iron, would always form the same compound, and exhibit the same general appearances; but this is not the case. The precipitate produced by galls is of a blackish blue; that of logwood has a different shade of blue; that by oak is a fawn-colour; that by quinquina of a blackish green, &c. These precipitates are also formed with different attendant circumstances, and when fixed on stuffs, are differently affected by alum and tartar. So that the substances denominated astringents form, with iron, different kinds of precipitates, and, consequently, do not derive their properties from an individual principle found in different vegetables. This diversity of properties has induced Dr Bancroft to rank the substances denominated astringents as colouring matters.—I have invariably applied the name of colouring matter," says he, "to those parts of vegetable dyeing drugs which are found to produce colour with an earthy or metallic basis; and I have certainly never been able to discover any good reason for doing otherwise, in regard to those vegetable matters which afford ink, or a black dye with iron; matters which, indeed, are extremely various in their other properties, and even in the sorts of black which they produce; though chemists have, as I think improperly, confounded most of them under the general denomination of astringents; a term which may be unobjectionable, as signifying acerbity in vegetables, but not as indicating, or being invariably connected with, any such property of matter as they have been supposed universally to possess, that of producing a black colour with iron."

231. Although chemists have considered the astringent principle as always the same, experience had taught us that all astringent substances were not equally proper for producing a beautiful and durable black. Of twenty-one species of astringents compared with galls, oak saw dust, and yellow myrobolans, were the only substances which produced a fine black, but inferior in beauty and durability to that obtained by means of the common gall. M. Beunie, who made the comparative trial of their properties in this respect, found that the oak saw dust was preferable to the bark, which is employed by the dyers of thread, and he remarks it is cheaper.

232. Lavosier, Vandermonde, Fourcroy, and Berthollet, were desired to try experiments on the different astringents, for the purpose of making a report on the subject to the academy. The substances upon which they instituted the experiments of comparison, were galls, oak-bark, raspings of heart of oak, of the external part of oak, of logwood, and sumach. To determine the proportion of astringent principal of each of these operations until the substances appeared exhausted; they then mixed together the decoctions belonging to each. They employed a transparent solution of sulphate of iron, in which the proportions of water and
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Of Mordants.

Sulphate were exactly known. They first estimated the quantity of the astringent principle by the quantity of sulphate which each liquor could decompose, and afterwards by the weight of the black precipitate which was formed. To saturate the decoction of two ounces of galls, three drams and sixty one grains of sulphate of iron were required, and the precipitate, when collected and dried, weighed seven drams twenty four grains. The decoction of oak bark is of a deep yellow; a very small portion of sulphate of iron gives it a dirty reddish colour, and a larger one changes it into a deep brown. The quantity of sulphate required to saturate the decoction of two ounces of this bark was eighteen grains, and the precipitate, when collected and dried, weighed twenty-two grains. The inner bark of the oak afforded very nearly the same result. The decoction of the rasplings of the heart of oak required for its saturation one drachm twenty four grains, and the precipitate obtained was of the same weight. The decoction of the external wood of the oak produced very little precipitate. The decoction of sumach acquired a reddish violet colour when a small quantity of the sulphate of iron was added. The quantity required for its saturation was two drachms, eighteen grains. The decoction of logwood became of a sapphire blue colour by the addition of sulphate of iron; beyond the point of saturation the blue becomes greenish and dirty. The exact quantity required for saturation was one drachm, forty eight grains, and the weight of the precipitate was two drachms, twelve grains. All the precipitations in which the oak was used took place readily; that by logwood a little more difficulty, but still more easily than that of galls. These eminent chemists afterwards ascertained, that the quantity of astringent substances required to give a black colour of equal intensity, to an equal weight of the same cloth, was proportional to the quantities of astringent principle which had been estimated in each kind by the foregoing experiments; but the black obtained by means of the different parts of the oak, did not resist proofs or tests so well as that produced by galls. It appeared also, that logwood alone was incapable of producing so intense a black as galls or oak, nor was the colour so permanent.

Having thus examined the properties of the astringent principle, with respect to its affinities with solutions of iron, it ought also to be considered with respect to its affinities with stuffs, since its action as a mordant must depend upon its attraction to the latter as well as to colouring matters. Silk acquires by galling, which consists in macerating a stuff in a decoction of galls, an addition to its weight which cannot be taken from it again, beyond a certain, by repeated washings; after which operation, the stuff, when put into a solution of iron, is dyed black, because the astringent principle, decomposing the sulphate of iron, forms a triple compound with the oxide of iron and the stuff.

A galled stuff is also capable of combining with other colouring particles, the colours of which thereby acquire fixity, if they do not naturally possess it, so that the astringent communicates its durability to the triple compound, or perhaps the more complex one which is formed, but the colour is commonly rendered deeper by this union.

As the mordants and colouring particles have a mutual action upon each other, the nature of the latter is often so much altered by their union, that by varying the mordants, we may multiply prodigiously the shades of colour obtained from the same colouring matter. This may be done by simply varying the mode of their application; thus we shall obtain different effects by impregnating the stuff with the mordant, or by mixing the mordant with the bath, by applying heat, or using repeated exsiccations. The greater or less disposition of the stuff to unite with the colouring matter, gives rise to considerable differences in the mode of applying the mordant. If the attraction of the colouring matter to the stuff be strong, the mordant may be mixed with the colouring matter, and in this state both may be presented at once to the stuff; but if it be weak, the compound formed by the mordant and colouring matter might, in this way, be precipitated in the bath without attaching itself to the stuff; and to prevent this inconvenience, the stuff must first be impregnated with the mordant, and afterwards exposed to the colouring matter. In the dyeing of some colours, it is necessary to employ one mordant for the stuff, and another for the colouring principle.

SECTION V.

Of the Processes of Dyeing.

CHAP. I.

General View of the Practical Operations of Dyeing.

In order that a dyeing manufactory may be conducted in the most advantageous manner, Berthollet remarks, it ought to be upon an extensive scale; the subdivision of labour affording an opportunity for each workman, by his attention being directed exclusively to one object, of acquiring dexterity and perfection of execution, while the whole operations are managed in a connected manner, and carried on in detail without loss of time. To these considerations it may be added, that a variety of materials, which, in a small establishment, would be rejected as useless, may often be applied with the utmost success to a different operation. Thus a bath which has been too much weakened for a particular colour, or even for the lighter shades of that colour, may frequently be found serviceable, by affording a ground for other stuffs, or forming a new bath by the addition of fresh ingredients.

A dye-house should be spacious, well lighted, and placed in a situation to command an easy and abundant supply of a stream of good water. The floor ought to be well paved, and proper gutters formed for carrying off dirty water and spent baths. In short, every thing should be constructed with a due regard to cleanliness, both on account of the health of the workmen, and the better performance of the different manipulations.

Dyeing houses should be built in exposed situations, and constructed in such a manner as to exclude the rays of light, while they admit a free current of air.

The caldrons, the size and position of which are to be regulated by the operations for which they are designed, should be made of brass or copper, unless for dyeing scarlet, in the preparation of which it is better to use tin vessels, as well as for other delicate colours in which a solution of tin is employed. Brass is preferable to copper, as it is less liable to be acted upon by saline substances, and thus to spot the stuffs. Vessels of a very large size should be furnished with stop-cocks at the bottom to empty them when necessary; and some contrivance should be employed above.
245. The water employed in preparing the baths should be as pure as possible. In every process, the exact temperature suited to each operation should be carefully attended to; and, in order that the stuff may be fully and equally saturated with the dye in every part, it is necessary to employ precautions, of which few dyers are sufficiently aware, who have not acquired considerable experience in the exercise of their art.

Having made these preliminary remarks, we shall now proceed to give a detailed view of the various processes which are employed for dyeing particular colours, observing the arrangement we proposed to adopt under the head of colouring matters.

CHAP. II.

Processes for Dyeing Red.

246. The colouring matters principally used in dyeing red, and its various shades, are cochineal, kermes, madder, carthamus, arsell, safflower, chay-root, Brazil-wood, sappanwood, camwood, barwood, red saunders, logwood, &c. Each of which we have already described. The shades of red given by these substances are various, and depend partly upon the nature of the colouring matter, and partly upon that of the mordant, with which it is employed.

I. Processes for Dyeing Woollen Red.

247. Of all the red colours communicated to wool by the process of dyeing, the finest and most splendid is scarlet. This beautiful colour is of different shades; sometimes it is required to be of a deeper and more perfect red, at other times to incline more or less to the colour of fire. It is difficult to obtain a particular shade, from the precise proportion of ingredients prescribed; because the quantity of colouring matter contained in different kinds of cochineal varies, and still more, because the solutions of tin differ so much from one another.

248. Dyeing scarlet is usually performed at two operations: the first is called the boiling; the second, the finish or reddening. For the boiling intended for dyeing 100 lbs. of cloth, 6 lbs. of pure tartar are thrown into the water when a little more than warm. The bath is briskly stirred, and when it has become a little warmer, half a pound of powdered cochineal is added, and well mixed. A moment after, 5 lbs. of very clear solution of tin are poured in and carefully mixed. As soon as the bath begins to boil, the cloth is put in and moved briskly for two or three turns, after which it is moved more slowly. The boiling having continued for two hours, it is taken out, aired, and carried to the river to be well washed.

249. To prepare the second bath, which is the reddening, the boiler is to be emptied. When the bath is ready to boil, 3 lbs. of cochineal, powdered and sifted, are put in. These being carefully mixed, when, after having ceased stirring, a crust, which forms on the surface, opens itself in several places, 13 lbs. or 14 lbs. of solution of tin are poured in. If, after that, the bath rises above the brim of the boiler, it must be cooled by the addition of cold water. When the solution is well mixed, the cloth is to be put into the bath, taking care to turn it quickly the first two or three turns. In this bath it is boiled for an hour, pushing it down with a stick when the boiling raises it up. It is then
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250. Such is the process for dyeing scarlet, as described by Berthollet. He adds, that the proportions of cochineal and of solution of tin, put either into the boiling or into the reddening, are not fixed. There are dyers who, according to Helot's account, succeed very well by putting two-thirds of the composition, and a fourth of the cochineal, into the boiling, and the remaining third of the composition, with the remaining three-fourths of the cochineal, into the reddening. Helot asserts also, that it does no harm to use tartar in the reddening, provided that not more of it than half the weight of the cochineal be put in; and it has appeared to him even to render the colour more permanent.

This is at present the practice of several dyers.

251. Some dyers do not take the cloth out of the boiling, only refreshing it to make the reddening in the same bath, by pouring in an infusion of cochineal, which they have made apart, and with which they have mixed the proper quantity of composition, i.e. solution of tin. In this way they save time and fuel, and obtain a scarlet equally fine.

Boilers.

252. In dyeing scarlet, it is of advantage to use tin boilers, because the acid employed attacks copper, and the solution it forms with it may affect the beauty of the colour. But as these are difficult to make of any considerable size, and are liable to melt if the workmen forget to withdraw the fire before emptying them, many dyers use copper boilers. It is necessary, however, to keep these very clean, not to allow the acid liquor to remain in them, and to prevent the cloth dyed in them from touching the copper, by means either of a net or a wicker basket.

253. Scheffer directs for the boiling an ounce and a half of solution of tin, with an equal quantity of starch, and as much tartar to every pound of cloth. He observes, that the starch serves to render the colour more uniform; and he directs, to throw into the water when it boils, a drachm of cochineal, to stir it well, to boil the wool an hour, and afterwards to wash it. The wool is then to be boiled half an hour in the reddening bath, with half an ounce of starch, three quarters of an ounce of solution of tin, half an ounce of tartar, and seven drachms of cochineal. It appears, that Scheffer employs a much smaller quantity of solution of tin than Helot; but Helot's solution, the manner of preparing which we described under Mordants (214.), contains much more tin.

254. Pernier describes three principal processes for dyeing scarlet, according as the colour is to be more or less deep, or more or less inclining to orange. He puts no cochineal into the boiling, which he compose of one ounce six drachms of tartar, and an equal weight of solution of tin, added after the tartar is dissolved, for every pound of cloth. After it has begun to boil, he introduces the cloth, and boils it for two hours. For the reddening of the first process, he uses two drachms of tartar, and an ounce of cochineal, afterwards adding gradually two ounces of solution of tin. For the reddening of the second process, he uses the same quantity of cochineal, and two ounces of solution of tin without any tartar. For the third, he directs two drachms of tartar, an ounce of solution of tin, and two ounces of common salt, with the above quantity of cochineal. The scarlet of the first process is of the deepest shade; that of the second is less full, but more lively; that of the third is still more bright and pale.

255. Dr Bancroft states, that he has often given to cloth a scarlet colour at a single but protracted boiling, by mixing the whole quantity of tartar, and solution of tin, and adding the cochineal, after the cloth has boiled ten or fifteen minutes; for such, says he, is the attraction of wool for the colouring matter, as well as for the oxide of tin, that it will take up both very freely, and retain them permanently, when thus mixed. He acknowledges, however, that in this way, the cloth is liable to imbibe both the mordant and the colour, with some inequalities, owing to differences in the quality of the wool; and that it is safest to employ a previous boiling in the way commonly practised. He also mentions, that he has often dyed very beautiful scarlets, by preparing or boiling the cloth with the whole quantity of solution of tin and tartar at once, (as is commonly done with alum and tartar), and afterwards dyeing it unrisned, with the whole of the cochineal in clean water only. In this way he found the colouring particles so completely taken up by the cloth, that the liquor became as clear as the purest water, and the colour was generally very good.

256. After having directed his attention very particularly, and for a long period of time, to the dyeing of scarlet, Dr Bancroft perceived that scarlet was in reality a compound colour, consisting of about three-fourths of a most lively pure crimson or rose-colour, and about one-fourth of a pure bright yellow; and, consequently, that when the natural crimson of the cochineal is made scarlet by the means always bitherto employed for dyeing that colour, there must be a change produced equivalent to a conversion of one-fourth of the cochineal colouring matter, from its natural crimson to the yellow colour; and as a better yellow might be obtained from other drugs where it naturally exists, and at a much cheaper rate than it costs obtained in this way, he concluded that the ordinary method of producing a scarlet was highly injudicious, because unnecessarily expensive.

"Convinced of this important truth," says he, "and at the same time believing too easily, on the authority of Helot, Macquer, and others, that the natural crimson of cochineal was rendered scarlet only by the nitric acid employed to dissolve the tin used in dyeing that colour, I began a series of experiments for producing it, without any such waste of the cochineal colouring matter. For this purpose, it seemed necessary to discover a mordant or basis, capable of permanently fixing, and strongly reflecting the pure vivid cochineal crimson or rose colour, without making it incite to the yellow. I concluded, and found by experiments, that the necessary purity and vivacity of colour could not be obtained from an aluminous basis, however dissolved, though it doubtless fixes the particles of cochineal more durably than any other mordant; and the like defect was found to accompany the solution of all the other earths, as well as of the metals, tin alone excepted; and with this further disadvantage, that most of them either degraded or altered the natural colour of cochineal very considerably. It followed, therefore, that a basis to suit my purpose must be sought for in the pure white calx or oxide of tin, so dissolved or combined, as to reflect the cochineal crimson unchanged, and with the greatest possible lustre. To produce a scarlet, therefore, it was only necessary to superadd, and intimately combine, with this crimson or rose colour, a suitable portion of a lively golden yellow, capable of being properly fixed and reflected by the same basis. Such a yellow I had previously discovered in the quercitron bark, and also in what is properly called young fustic, (Rhyna cotinus), though its colour was less
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bright and less durable than that of the quercitron bark. This last had also the advantage of being not only the brightest, but the cheapest of all yellows; since one pound of the bark in powder, which cost but threc- pence farthing, dyed, with a sufficient quantity of mutriate of tin, between thirty and forty pounds weight of woollen cloth, of a full bright golden yellow; and this being afterwards dyed in the same liquor, with one-fourth less of cochineal than what is usually employed, acquired a scarlet, equal in beauty and durability to any which is usually given by the ordinary means with a full proportion of cochineal; and such were the general results of a great number of experiments."

257. Dr Bancroft was accordingly induced to make trial of this method of dyeing scarlet on a large scale, at the dye-house of Messrs Goodwin, Platt & Co. Bankside, Southwark; but owing to the mutriate of tin being either too much concentrated, or too highly oxygenized, the result was far from being attended with the success expected. In a subsequent trial, in which a nitro-mutriate of tin was used, by mixing the mutriatic acid with about one-third less than its weight of the nitric, the mordant acted very feebly, or rather failed in exalting the yellow colour of the bark, which took but slowly on the stuff, and never rose higher than a straw colour; while a considerable quantity of yellow colouring matter, united to the calx of tin, remained floating in the bath, "not because the calx was too intimately combined with the acid, as in the first experiment, but because for want of a sufficient attraction between them, it had been almost wholly decomposed as soon as they were put into water; and in boiling, it fixed itself with the bark colour upon the cloth very sparingly, superficially, and slowly.

258. "As this nitro-mutriate of tin," says Dr Bancroft, "though exempt from the defects of the mutriatic solution, had failed through others of a very opposite nature, I was induced to mix much greater proportions of nitric with mutriatic acid, for dissolving tin, in order to see how much of the former could be used in this way, without so far yellowing the cochineal crimson as to prejudice the use of any of the quicks of the other dyes in the dyeing of scarlet, an effect which I still expected from the nitric acid, when used in a very large proportion; but, to my great surprise, I could discover no such effect, even when I had dissolved the metal in nitric acid alone. At first I suspected some impurity in the acid which had been employed; but having procured a fresh supply, and ascertained its purity by the proper means, I still found that tin dissolved by it, had not the least tendency to change the cochineal crimson towards a yellowish or scarlet hue; and that this effect, in the usual way of dyeing that colour, resulted wholly from the tartar, (acculated tartrate of potash,) which is always employed at the same time. This fact I ascertained by repeated and varied experiments, in which I constantly found that cochineal, with the dyer's common solution of tin, and even with that made by nitric acid only, would produce nothing but a crimson, without tartar; and that cochineal, with tartar, would produce a scarlet, not only with these last mentioned solutions, but also, and equally well, with the mutriatic solution of that metal; and therefore that every thing which had been taught and believed to the contrary, was repugnant to truth. And here I cannot conceal my wonder, that an error of so much consequence, and so destitute of all foundation, should have been propagated and confirmed by so many acute reasoners and sagacious observers in other respects; for, besides other eminent writers, Mr Poerner has more recently adopted and propagated the same error, after making a great number of experiments, several of which, if they had been duly considered, would have taught him the truth on this subject. This was even more lately done by Berthollet, in his Elements de l'Art de la Tinture, where, to adopt the words of Dr. Hamilton's translation, he says, "Tartar, as we have seen, gives a deeper and more rosy hue to the colouring matter of cochineal, precipitated by the solution of tin. It moderates the action of the nitro-mutriatic acid, which tends to give scarlet an orange cast, though this orange cast is not to be seen in the precipitate produced by the solution of tin, which is, on the contrary, of a fine red. That is probable, and it is certain the tin gives scarlet an orange tint by means of the action of the nitro-mutriatic acid exerts on the wool, which, as well as all other animal substances, it has the property of turning yellow. Thus, (adds he,) by putting more of tartar into the reddening, a deeper and fuller scarlet may be obtained; and on the contrary, the scarlet may be rendered more inclining to orange, by omitting this ingredient." Here then it is manifest, (says Dr Bancroft,) that the nitro-mutriates of tin are each supposed to produce effects directly contrary to what are really produced by them, the effects of each being ascribed to the other; a mistake capable of producing much disappointment and detriment. In the last edition of his Elements on Dyeing, Berthollet has accordingly, with much candour, acknowledged his error, and admitted the truth of Dr Bancroft's observations.

259. Had Dr Bancroft's attempts to simplify and improve the method of dyeing scarlet with cochineal, produced no other effect than the correction of a mistake, which had prevailed so long and so universally, the result, even in this point of view, might have justly been deemed important; but the failures which he had hitherto experienced in realizing his speculative opinions, instead of diminishing his confidence in his former reasoning, only increased his diligence in searching after more suitable means for accomplishing his purpose, and length, after various experiments, he discovered that the muri-sulphate of tin, the composition of which we have already described (216.), formed an excellent mordant for the process he had proposed.

260. To dye a scarlet with this mordant, it is necessary to put the cloth, suppose 100 lb. weight, into a proper tin vessel, nearly filled with water, in which about 8 lb. of the muri-sulphuric solution of tin have been previously mixed, to make the liquor boil, turning the cloth as usual through it by the winch, for a quarter of an hour; then taking the cloth out of the liquor, to put it into about four pounds of cochineal, and two pounds and a half of quercitron bark in powder; and having mixed them well, to return the cloth again into the liquor, making it boil, and continuing the operation as usual, until the colour be duly raised, and the bath exhausted, which will be the case in about fifteen or twenty minutes; after which, the cloth may be taken out and rinsed as usual. "In this way," says Dr Bancroft, "the time, labour, and fuel necessary for filling and heating the dyeing vessel a second time, will be saved; the operation finished much more speedily than in the common way; and there will be a saving of all the tartar, as well as of two thirds of the cost of spirit, or nitro-mutriatic solution of tin, which for dyeing 100 lbs. of wool, commonly amounts to 10s.; whereas 8 lbs. of the muri-sulphuric solution will only cost about 3s. There will be, moreover, a saving of at least one-fourth of the cochineal usually employed (which is..."
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Dyeing generally computed at the rate of one ounce for every pound of cloth, and the colour produced will certainly not prove inferior, in any respect, to that dyed with much more expense and trouble, in the ordinary way. When a rose colour is wanted, it may be readily and cheaply dyed in this way, only omitting the quercitron bark, instead of the complex method now practised, of first producing a scarlet, and then changing it to a rose, by the volatile alkali contained in stale urine, set free or decomposed by potash or by lime; and even if any one should still unwise to continue the practice of dyeing scarlet without quercitron bark, he need only employ the usual proportions of tartar and cochineal, with a suitable quantity of the muriro-sulphate of tin, which, while it costs so much less, will be more effectual than the dyer's spirit.

261. "Several hundreds of experiments warrant my assertion, that at least a fourth part of the cochineal generally employed in dyeing scarlet, may be saved by obtaining so much yellow as is necessary to compose this colour from the quercitron bark; and indeed nothing can be more self-evident, than that such an effect, *ce tersa paribus* ought necessarily to result from this combination of different colouring matters, suited to produce the compound colour in question."

262. "The scarlet composed of cochineal crimson, and quercitron yellow, is moreover attended with this advantage, that it may be dyed upon wool and woollen yarn, without any danger of its being changed to a rose or crimson, by the process of fulling, as always happens to scarlet dyed by the usual means. This last being, in fact, nothing but a crimson or rose colour, yellowed by some specific or particular action of the acid of tartar, is liable to be made crimson again by the application of many chemical agents (which readily overcome the changeable yellow produced by the tartar), and particularly by calcareous earths, soap, alkali salts, &c. But where the cochineal colouring matter is applied and fixed, merely as a crimson or rose colour, and is rendered scarlet by superadding a very permanent quercitron yellow, capable of resisting the strongest acids and alkalies (which it does when dyed with solutions of tin), no such change can take place, because the cochineal colour having never ceased to be crimson, cannot be rendered more so, and therefore cannot suffer by those impressions or applications which frequently change or spot scarlets dyed according to the present practice."

263. "There is also a singular property attending the compound scarlet dyed with cochineal and quercitron bark, which is, that if it be compared with another piece of scarlet dyed in the usual way, and both appear by day-light exactly of the same shade, the former if they be afterwards compared by candle-light, will appear to be at least several shades higher and fuller than the latter; a circumstance of some importance, when it is considered how much this and other gay colours are generally worn and exhibited by candle light during a considerable part of the year."

264. "To illustrate more clearly," continues Dr Bancroft, "the effects of the muriro-sulphuric solution of tin with cochineal in dyeing, I shall state a very few of my numerous experiments therewith; observing, however, that they were all several times repeated, and always with similar effects:

- 1st, I boiled one hundred parts of woollen cloth in water, with eight parts of the muriro-sulphuric solution of tin, during the space of ten or fifteen minutes; I then added to the same water four parts of cochineal, and two parts and a half of quercitron bark in powder, and boiled the cloth fifteen or twenty minutes longer, at the end of which it had nearly imbibed all the colour of the dyeing liquor, and received a very good, even, and bright scarlet. Similar cloth dyed of that colour at the same time in the usual way, and with a fourth part more of cochineal, was found upon comparison to have somewhat less body than the former; the effect of the quercitron bark in the first case having been more than equal to the additional portion of cochineal employed in the latter, and made yellow by the action of tartar.

"2d, To see whether the tartrite of tin would, besides yellowing the cochineal crimson, contribute to raise and extant its colour more than the muriro-sulphate of that metal, I boiled a hundred parts of cloth with eight parts of the muriro-sulphuric solution, and six parts of tartar, for the space of one hour; I then dyed the cloth unrinased, in clear water, with four parts of cochineal, and two parts and a half of quercitron bark, which produced a bright aurora colour, because a double portion of yellow had been here produced, first by the quercitron bark, and then by the action of tartar upon the cochineal colouring matter. To bring back this aurora to the scarlet colour, by taking away or changing the yellow produced by the tartar, I divided the cloth whilst unrinased into three equal parts, and boiled one of them a few minutes in water, slightly impregnated with potash; another in water with a little ammonia; and the third in water containing a very little powdered chalk, by which all the pieces became scarlet; but the two last appeared brighter than the first, the ammonia and the chalk having each rosetled the cochineal colour rather more advantageously than the potash. The best of these, however, by comparison, did not seem preferable to the compound scarlet dyed without tartar, as in the preceding experiment; consequently, this did not seem to exalt the cochineal colour more than the muriro-sulphate of tin; had it done so, the use of it in this way would have been easy, without relinquishing the advantages of the quercitron yellow.

"3d, I boiled one hundred parts of woollen cloth with eight parts of the muriro-sulphuric solution of tin for about ten minutes, and then added four parts of cochineal in powder, which by ten or fifteen minutes more of boiling, produced a fine crimson. This I divided into two equal parts, one of which I yellowed, or made scarlet, by boiling it for fifteen minutes with a tenth of its weight of tartar, in clear water; and the other, by boiling it with afortieth of its weight of quercitron bark, and the same weight of muriro-sulphuric solution of tin; so that in this last case, there was an addition of yellow colouring matter from the bark, whilst in the former, no such addition took place, the yellow necessary for producing the scarlet having been gained by a change and diminution of the cochineal crimson or rose-colour, and the two pieces being compared with each other, that which had been rendered scarlet by an addition of quercitron yellow was, as might have been expected, several shades fuller than the other.

"4th, I dyed one hundred parts of woollen cloth scarlet, by boiling it first in water, with eight parts of muriro-sulphate of tin, and twelve parts of tartar, for ten minutes, and then adding five parts of cochineal, and continuing the boiling for fifteen minutes. This scarlet cloth I divided equally, and made one part crimson, by boiling it with a little ammonia in clean water; after which I again rendered it scarlet by boiling it in
clean water, with a fourth of its weight of quercitron bark, and the same weight of muri acid sulphate of tin; and this last, being compared with the other half, to which no quercitron yellow had been applied, was found to possess the most colour, as might have been expected. A piece of the cloth which had been dyed scarlet by cochinile and quercitron bark, was, in the first experiment, being at the same time boiled in the same water with ammonia, did not become crimson, like that dyed scarlet without the bark.

"In this way of compounding a scarlet from cochineal and quercitron bark, the dyer will at all times be able, with the utmost certainty, to produce every possible shade between the crimson and yellow colours, by only increasing or diminishing the proportion of bark. It has, indeed, been usual at times, when scarlet approaching nearly to the aurora colour were in fashion, to superadd a fugitive yellow, either from turmeric, or from what is called young fustic (Rhizus colinus); but this was only when the cochineal colour had been previously yellowed as much as possible by the use of tartar, as in the common way of dyeing scarlet; and therefore that practice ought not to be confounded with my improvement, which has for its object to preclude the loss of any part of the cochineal rose or crimson, by its conversion towards a yellow colour, which may be so much more cheaply obtained from the quercitron bark."

"By sufficient trials, I have satisfied myself that the cochineal colours, dyed with the muri sulphur solution of tin, are in every respect at least as durable as any which can be dyed with any other preparation of that metal; and they even seem to withstand the action of boiling soap, such as soberer, and therefore I can not avoid earnestly recommending its use for dyeing rose and other cochineal colours, as well as for compounding a scarlet with the quercitron bark." (Phil. of Perm. Colours. i. 485.) Such are the results of Dr Bancroft’s researches on this very important colour. His experiments certainly deserve the attention of the practical dyer; and, indeed, we understand that a portion of yellow colouring matter obtained from the quercitron bark, or Rhizus colinus, is now very generally employed in this country with cochineal for dyeing scarlet. The tartar is not, however, entirely abandoned, though it is much more sparingly used than formerly.

249. As the reddening which has been used for dyeing scarlet is never entirely exhausted of its colouring matter, but still contains a portion which varies in quantity according to the fineness of the powder to which the cochineal was reduced, and the length of time it has been boiled, it may still be employed to produce shades of a darker cast; but the nature of the residue being somewhat the same, it would be vain to point out the particular colours to be dyed with it, or the ingredients necessary to be added for brighter shades. Every thing, in such cases, must be left to the skill and experience of the practical dyer.

265. As wool is dyed with kermes, by first boiling it half an hour in water with bran; then two hours in a fresh bath, with one-fifth of Rouge alum, and one-tenth of tartar, to which 809. water (42.) is commonly added; after which it is taken out, tied up in a linen bag, and carried to a cool place, where it is left some days. To obtain a full colour, as much kermes as equals three-fourths, or even the whole of the weight of the wool, is put into a warm bath, and the wool is put in at the first boiling. Cloth being more dense than wool, either spun or in the fleece, it requires one-fourth less of the salts in the boiling, and of kermes in the bath. Before the wool which has just been dyed is taken to the river, it may be dipped in a bath of water, a little warm, in which a small quantity of soap has been dissolved. In this way the colour will acquire more brightness, though it will be rendered a little of a rosy or crimson cast.

267. Solution of tin has been tried with kermes as well as with cochineal. Scheffer describes several processes for dyeing in this way, but the colour always inclines to yellow or cinnamon, because the compound formed of its colouring matter and the oxide of tin always retains a yellow hue. Berthollet ascribes this to the action of the acid, but it is more probably owing, as in the case of cochineal scarlet, to that of the tartar. Dr Bancroft affirms, that with the same bases or mordants, the colours from cochineal and from kermes closely resembled each other.

268. The red colour dyed upon wool with madder, is greatly inferior in beauty to that obtained from cochineal or kermes; but it has the advantage of being cheaper and more durable. It is, therefore, often applied to coarser stuffs, which cannot admit of expensive dyes. Before a woollen stuff is put into the madder bath, it is first impregnated with a suitable mordant, by boiling it for two or three hours with alum and tartar. It is then left to drain, and after being slightly wrung and put into a linen bag, it is carried to a cool place, where it is allowed to remain for several days.

269. The quantities of alum and tartar vary in different manufactories. Hellet recommends five ounces of alum and one ounce of tartar to each pound of wool. Poerner diminishes the proportion of tartar, and directs that it should be only one-seventh of the alum; while Scheffer, on the contrary, says, that the quantity of tartar should be double that of the alum. Berthollet found that by employing one half tartar, the colour sensitively bordered more on the cinnamon than when the proportion was only one-fourth. Dr Bancroft states the proportions of the aluminous mordant to be, the alum one-fourth or one-sixth, and the tartar one-twelfth or one-sixteenth of the weight of the stuff."

270. In preparing the madder, the bath must not be allowed to boil, because that degree of heat would dissolve the fawn-coloured particles, which are less soluble than the red, and thus debase the colour. After the water has reached a temperature which the hand can just bear, Hellet directs us to throw in half a pound of the best grape madder for each pound of wool to be dyed, and to stir it well before the wool is put in, which must remain for an hour without boiling; after which it is recommended, in order that the colour may be more effectually fixed, to boil it for four or five minutes at the end of the operation. "Whether the colour be in reality fixed more permanently by boiling the dyed cloths a few minutes, as is commonly practised at the conclusion of the operation, is a question (says Dr Bancroft) which I am afraid to answer, as the results of several trials which I have made were not uniform; but if it should be found expedient to employ a boiling heat for this purpose, all danger of any harm from it might be avoided, by giving it with clean water, in a separate pan, to which the cloths might be removed, after having already imbied sufficient colour, with only a scalding heat; in this way there would be no danger of increasing the extraction of the yellowish-brown colouring matter, or promoting its application either to the cloth, or the aluminous basis." See Phil. of Perm. Col. ii. 227.
271. The quantity of madder employed by Parter is only one-third the weight of the wool, and Scheffer advises only one-fourth. Parter says, that having added to the alum and tartar a quantity of solution of tin of equal weight with the tartar, and after two hours boiling, having let the cloth remain in the bath that had been left to cool for three or four days, he dyed it in the usual way, and obtained a pleasing red. He describes another process, in which, after having prepared the cloth by the common boiling, he dyed it in a bath but slightly heated, with a larger quantity of madder, tartar, and solution of tin; he let the cloth remain twenty-four hours in the bath, and after it had become cold, he put it into another bath made with madder only, and there left it for twenty-four hours. In this way he obtained a pleasing red, a little clearer than the common red, and inclining somewhat to yellow.

272. By composing a bath of cochineal and madder, in the proportion of from two to three, or even four pounds of the latter, with one pound of the former, Dr Bancroft obtained, with the muri-rothiate of tin as a mordant, a scarlet which was little inferior to one procured in the ordinary way, from cochineal alone.

273. Madder reds are sometimes rosed, or heightened in brilliancy, with archil and brazil-wood. This process renders them more beautiful and velvety, but the brightness given them in this way soon fades.

274. Wool may be dyed crimson, of various shades, either by giving it that colour at once, or by first dyeing it scarlet, and then deepening it to the desired shade.

275. To dye crimson by a single process, a solution of two ounces and a half of alum, and an ounce and a half of tartar, to every pound of cloth, is used for the boiling; and the cloth is afterwards dyed with an ounce of cochineal. Solution of tin is commonly added, but in less proportion than for scarlet. The processes employed vary greatly, according as the shade required is deeper or lighter, or more or less distant from scarlet. Some use common salt in the boiling.

276. Archil and potash are frequently used for saddening crimson, and giving them more bloom; but the effect which these substances produce soon vanishes. The boiling for crimson is sometimes prepared from a scarlet bath, by the addition of tartar and alum; and it is even affirmed, that the soupe au vin has more bloom, if both its boiling and reddening be made after scarlet, than when it is dyed in a fresh bath.

277. The colour of scarlet is converted into a crimson, by all those substances which counteract the effects of the tartar and solution of tin, employed for giving the former of these colours. Thus the alkalies, alum, and several other earthy salts, change the colour of scarlet to crimson, which is the natural colour of cochineal. Accordingly, if a stuff previously dyed scarlet be boiled for about an hour in a solution of alum, it will become a crimson, which may be rendered of any required shade, by varying the strength of the solution.

278. Crimmins in half grain are made by substituting madder for half the quantity of the cochineal, and following in other respects the processes for reddening. Other proportions may be employed according to the intended effect.

279. Wool may be dyed red by means of carthamus, but the colour soon changes to orange; and as the red thus imparted is inferior to what is obtained from cochineal, both in point of beauty and durability, the use of this dye for wool is entirely relinquished.
of water. The silk is allowed to remain twenty-four hours in this solution; it is then taken out, and washed in clean water till it ceases to render it turbid. The silk is dyed by boiling it a quarter of an hour with five-sixths of its weight of cochineal, in a small quantity of water.

286. Scheffer describes some variations in his process, by which different shades are obtained. If the silk be wrung out of the solution of tin, left all night in a cold solution of alum, (composed of an ounce to a quart of water,) wrung and dried, then washed, and afterwards boiled with cochineal, it will take only a pale poppy colour. If the silk be steeped twelve hours in the solution of tin diluted with eight parts of water, then left all night in the solution of alum, washed, dried, and passed through two baths of cochineal as before, adding to the second bath a little sulphuric acid, it will assume a fine poppy red.

287. Berthollet remarks, with respect to these processes, that though he varied his experiments in several ways, he was never able to obtain a shade comparable to scarlet; and he adds, that by the information he obtained from persons who assisted at Maquer's trials at the Gobelins, the silk dyed by his process never reached that colour. Scarlet, however, is so much in request, that the attention of several individuals has been excited to discover means of giving it to silk.

Those who have been most successful in France, begin with dyeing the silk crimson; this dye is covered over with one of carthamus, by a process which we shall afterwards describe; and, lastly, they give it a yellow dye without heat. By these means, a fine colour is produced, but the action of the air soon destroys the dye of the carthamus, and darkens the shade.

288. Dr Bancroft recommends the following process:

Soak the silk for the space of two hours, in a solution of the muri-o-sulphate of tin, diluted with about five times its weight of water; take it out of the solution, and let it be moderately squeezed or pressed, and afterwards partially dried; and, lastly, dye it as usual, in a bath prepared with cochineal and quercitron bark, in the proportion of four parts of the former to three of the latter. The colour thus imparted to the silk will approach very nearly to a scarlet. A better body may be communicated to it by a further slight immersion into the diluted muri-o-sulphate of tin, and a second dyeing in the bath with cochineal and quercitron bark. If afterwards a little of the red colouring matter of safflower be superadded, by the usual method of applying it, a good scarlet may be produced.

289. A colour denominated false crimson, to distinguish it from the cochineal crimson, is imparted to silk, by means of Brazil wood. To apply this dye, the silk should be boiled with soap, in the proportion of twenty pounds, of the latter to a hundred of the former, and afterwards alumed. Less aluming is required for this than for grain or cochineal crimson. Having refreshed it at the river, it is dipped in a bath more or less charged with the colour of the Brazil wood, according to the shade to be given. If water containing no earthy salt be employed, the colour will be too red for crimson; but this may be remedied by passing the stuff through a slight alkaline solution, or by the addition of a little alkali to the bath. False crimson may be rendered deeper, by adding juice of logwood to the Brazil bath, after the silk has been impregnated with the latter. To imitate poppy or fire colour, the silk should receive an annotta ground; after which it is washed, alumed, and dyed with the Brazil juice, to which a little soap-suds is usually added.

290. Madder is seldom used for dyeing silk, as its colour is not sufficiently delicate and bright for the purpose. The following processes, however, have been recommended. According to the process of De la Folie, half a pound of alum is to be dissolved in each quart of hot water, to which two ounces of potash are to be added; after the effervescence has ceased, and the liquor has begun to grow clear, the silk must be soaked in it for two hours, and then washed and put into a madder bath. The process of Scheffer is somewhat different: the silk is to be alumed in a solution of four ounces of alum, with six drachms of chalk, for each pound of scoured silk; when a sediment is formed, the solution is to be decanted; and after having become quite cold, the silk is to be put into it, and to be left eighteen hours. It is then taken out and dried, after which it is dyed with an equal weight of madder, when it takes a pretty good, but rather dark colour. Guichlic also describes a process for dyeing silk with madder; for one pound of silk, he orders a bath of four ounces of alum, and one ounce of a solution of tin.

The liquor is to be left to settle, when it is decanted, and the silk carefully soaked in it, and left for twelve hours. It is then immersed in a bath, containing half a pound of madder, softened by boiling, with an infusion of galls in white wine; this bath is kept moderately hot for an hour, after which it is to be made to boil for two minutes. After being taken out of the bath, the silk is to be washed in a stream of water, and dried in the sun. The brightness of the colour may be raised, by afterwards passing it through a bath of Brazil wood, to which an ounce of solution of tin has been added.

291. Carthamus is employed for dyeing silk poppy-colour, a bright orange red, cherry, rose, and flesh-colour. The processes differ according to the intensity of the colour to be given, and the degree in which it is to approach that of fire: but the carthamus bath, which varies in the mode of using it, is prepared in the following manner: After having extracted the yellow matter of the carthamus, and opened the cakes, it is put into a deal trough, where it is sprinkled at different times with soda, well powdered and sifted, in the proportion of six pounds to a hundred. The carthamus being well mixed with the alkali, is put into a small trough, with a grated bottom, lined with a closely woven cloth. When this cloth is nearly half filled, it is placed upon the large one, and cold water is poured on it till the lower trough is full. The carthamus is then set over another trough till the water comes from it almost colourless; a little more alkali is then added, and fresh water poured on. These operations are repeated till the carthamus is exhausted and becomes yellow. The silk being distributed on the rods in hanks, lemon juice, or one of the acids formerly recommended, (82,) is poured into the bath, till it assumes a fine cherry colour. Having stirred the bath well, the silk is dipped in, and turned on the skinn sticks, as long as it appears to gain colour. For poppy colour, it is taken out, wrung, drained, and passed through a new bath, where it is treated as in the former. It is then dried, and passed through fresh baths, washing and drying it after every operation, till it acquires the desired shade. When it has taken the proper colour, it is heightened, by turning it seven or eight times in a bath of hot water, to every bucket of which, about a gallon of lemon juice is to be added.
292. If a poppy or fire colour is to be given, the silk must be first scoured as for white, and then receive a slight annotta ground; but it must not be alumined.

Bright orange red, and deep cherry colours, are treated in the same way as poppy colour, except that they have not the annotta ground. The lighter cherry colours, rose colours of every shade, and flesh colours, are made from baths of the second and third running of the carthamus, which are weaker than the first. The lightest of all these shades, which is a very pale flesh colour, requires a little soap to be put into the bath: this softens the colour, and prevents it from taking too quickly or unevenly.

293. The baths of carthamus are used as soon as they are prepared, and as quickly as possible, as their colour loses much by keeping; and indeed, after some time, entirely disappears. They are also used cold, because the red eculee lose their colour by exposure to heat.

III. Processes for Dyeing Cotton and Linen Red.

Cochineal. 294. Cochineal, which, by the aid of the oxides of tin, imparts the most beautiful of all dyes to wool, communicates to cotton and linen a colour which possesses neither beauty nor durability. If cotton be impregnated, however, with the aluminous mordant, it receives, when dyed with cochineal, a very beautiful crimson, capable of bearing several washings, and of resisting, for some time, the action of the air, though not long enough to deserve the appellation of a fast colour.

Madder. 295. Madder is therefore usually employed for dyeing red, and its various shades, upon cotton and linen; and in this respect it is certainly the most useful of all colouring substances. Its affinity for linen is more feeble than for cotton, but the processes which are employed for fixing it upon the one, are found to answer best when applied to the other; we shall accordingly make no distinction between them.

296. The madder red communicated to cotton, is distinguished into two kinds: the one is called simple madder red, and the other, which is much brighter, and more permanent, Turkey, or Adrianople red. Both are dyed upon the aluminous basis, but with a considerable difference in the subordinate parts of the process.

297. Madder reds also differ greatly, both in beauty and permanency, according to the processes employed. For the common madder red, linen or cotton, after being boiled in a weak lixivium of potash or soda, is to be macerated in a decoction of powdered galls, in the proportion of four ounces to every pound of linen or cotton to be dyed. After it is duly impregnated with the solution of galls, and dried, the stuff is alumined, by soaking it thoroughly in a saturated lukewarm solution of alum, employed also at the rate of four ounces to each pound of linen or cotton, the excess of sulphuric acid having been previously neutralized in the alum, by adding to the solution an ounce of soda for every pound of alum. When this has been done, the stuff is moderately wrung; it is then dried, and afterwards alumined a second time, dissolving for that purpose half as much alum as for the first alumining, and adding to it the residue of the former solution. After this second alumining, it is again well dried, and then rinsed, to remove the superfluous alum which has not united itself to the stuff. The acetate of alumine may be substituted for common alum, with greater advantage to the process, but it would be attended with more expense.

298. The linen or cotton having been thus impregnated with the alumina basis, is to be dyed with the best madder, at the rate of three-fourths of a pound for each pound of stuff. The heat of the bath is gradually raised, so as to make it begin to boil in about fifty minutes, or at most an hour; after the boiling has continued a very few minutes, the stuff is taken out, and slightly rinsed; it is then dyed a second time in the same manner, and with the same quantity of madder. After the second dyeing, followed by the usual rinsing and drying, it is commonly thought expedient to steep the linen or cotton in a lukewarm solution of soap, in the proportion of about two ounces of the latter to each pound of stuff, in order to give greater brilliancy to the red colour, and remove all the uncombined colouring matter. The process is completed by rinsing and drying as usual.

299. The Adrianople or Turkey red possesses a greater degree of brightness than the common madder red, and resists more powerfully the effects of different red agents, such as alkalies, acids, alum, and soap. It appears, from the inquiries of Dr Bancrot, respecting this beautiful dye, that the complicated process by which the Turkey red can alone be dyed, was long ago practised, and perhaps invented, by the inhabitants of Malabar and Coromandel; that a knowledge of it was carried from India to Persia, Armenia, Syria, and Greece, and after a long interval to France, in consequence of the accounts transmitted at different times, by the French ambassadors resident at Constantinople, of the means employed to dye this red, particularly at Adrianople. See Phil. Perm. Col. vol. ii. p. 246.

300. The Abbé Mazes published some experiments concerning this dye, which threw a considerable light on the subject, and the French government, from the information it received, published, in 1765, an instruction under the title of A Memoir containing the process for dyeing spun cotton of the same scarlet red as that of the Adrianople cotton. The directions given in this memoir, were first attempted to be reduced to practice at Rouen, or near that city; but, for a considerable time, with very little success. At present, however, the Turkey red is supposed to be dyed in that part of France as beautifully and durably, as in Greece or any part of the Ottoman empire. The steps of the process are carried on, with considerable modifications, in different manufactories, but as they are generally kept secret, we have little means of selecting those which have been found to answer best. The following description is given by Berthollet of the method followed by M. Clerc, who had the management of a manufactury at Vaudreuil, and sent him patterns of his cotton dyed of a beautiful and durable red.

301. "When a hundred pounds of cotton are to be M. Clerc's dyed, we must begin by scouring it well. This operation consists in boiling the cotton in a ley of soda, marking one degree of the areometer, to which is commonly added the remainder of the bath, which has been employed for passing the cottons through for the white preparation called siccian.

"In order to scour the cotton properly, and prevent it from entangling, a cord is passed through three hawks, each of which weighs a pound, and it is thrown into the ley when it begins to boil; it is carefully immersed, that it may not be scorched by the upper part of the caldron, which should contain about 150 gallons of
Processes of Dyeing.

Second operation. Bath with dung.

Dyeing.

Water for 100 pounds of cotton. The cotton is completely scoured when it sinks of itself in the caldron; it is then taken out, and washed by knot in the river, wrung, and hung out to dry.

"A hundred pounds of Alicante soda (barilla) in coarse powder are put into a tub, with a hole near its bottom to allow the water to run into another tub placed under it; seventy-five gallons of liquor is poured on the soda in the upper tub; when the water which has run into the lower one marks two degrees of the soap-makers' arometer, it is proper for the bath with dung, which is made in the following manner:

"Twenty-five or thirty pounds of sheep dung are mixed with the above ley in a large earthen vessel, and stirred with a wooden pestle, then passed through a hair sieve placed over the vat in which the bath is to be prepared. Twelve pounds and a half of Provence oil are then poured into the vat, and kept constantly stirring with a rake, that it may be perfectly mixed with the ley and the dung; the soda ley is poured upon it, and five buckets of water (each equal to four gallons) are commonly required for a hundred pounds of cotton. The bath being thus prepared, is in a proper state to receive the cotton. For this purpose; some of the bath is taken in a wooden bowl, and poured into an earthen pan set in brickwork, at a proper height for working. A hank of cotton is taken and well wrought with the hands; it is frequently taken up and turned in the pan, and then hung upon a wooden peg fixed to the wall; it is slightly wrung out, and thrown upon a table; and the same operation is repeated with each hank. The table upon which the cotton is thrown ought to be raised eight or ten inches from the ground. A workman takes a hank in each hand, and strikes on the table to stretch the threads; he turns it three times, and then makes a small twist to form a head for the hank, and lays it upon the table. Not more than three hanks should be placed one upon another, as too great weight would squeeze the bath out of the under hanks. The cotton ought to remain ten or twelve hours on the table, and then be hung out to dry.

"Ley of soda also at two degrees of the arometer is taken; and after the vat in which the bath with dung was made has been well cleaned, twelve pounds and a half of olive oil are put into it, and the ley of soda added, while it is kept constantly stirred with a rake, in order to mix the oil completely. This bath ought to resemble thick milk; and that it may be good, it is necessary that the oil should not rise to the surface. Some of this bath is then put into the pan, and the cotton dipped hank by hank, as in the former operation. It is then thrown on the table and beat upon it; it is left there till the next day, and then hung out to dry. For this bath about eight buckets of ley are required.

"Fresh soda is added to the remainder of that first put into the tub, if the water poured upon it has not attained three degrees. For this operation, eight buckets of ley are poured into the vat upon the remains of the white bath, and the cotton is passed through it in the same manner as before.

"The cotton is passed through a ley of soda at four degrees, the working being conducted as already described.

"The cotton is passed through a ley of soda at five degrees.

"The cotton is passed through a ley of soda at six degrees, the same precautions being observed, and then carried out to be dried on very small poles; when dry, it is taken to the river to be washed in the following manner:

"The cotton must be first soaked in the water, then taken out and put upon the horse to drain. Water is repeatedly thrown on it that it may be well soaked, and an hour after it is washed knot by knot, to free it completely from the oil, which is absolutely necessary to its taking the galling well. It is then wrung with the jack and pin, and stretched upon the poles to dry. The cotton, when thus washed, ought to be of a beautiful white.

"For the galling, we must choose good galls in sorts, and having bruised them, put for each hundred pounds of cotton twelve pounds and a half into a copper, and boil them in six buckets of clear river water. Three hours are generally required to boil them sufficiently; and we perceive that this is accomplished when they break readily between the fingers. Three buckets of cold water are then added, and the whole passed through a very close hair sieve, squeezing with the hand what has passed through, in order to separate all the resinous particles. When the water has settled and become clear, the galling is performed in the following manner. Nine or ten quarts of the galling is poured into an earthen pan set in the wall at a height convenient for working; and the cotton is dipped into it by separate hanks, working it well with the hands. It is then wrung with the pin, and carried out to be dried as fast as it is dipped; a precaution essentially necessary to prevent the cotton from growing black. When the cotton is thoroughly dried, we proceed to the aluming, in the following manner:

"The copper in which the decoction of galls was made being well cleaned, eight buckets of river water, and eighteen pounds of Roman alum, are put into it, and the alum dissolved without boiling. When the solution is complete, half a bucket of soda ley at four degrees of the arometer is added, and the cotton then wrought in it hank by hank, as in the galling. It is then spread out to dry, and afterwards washed from the alum, as follows:

"Having left the cotton to soak and drain for an hour upon the horse, each hank is washed separately three times, wrung with a pin, and carried to the tenter ground.

"This operation consists in a repetition of the former ones. A white bath is prepared, similar to that described in the third operation; twelve pounds and a half of Provence oil are put into a vat; and eight buckets of ley, at two degrees of the soapmaker's arometer, added to it; and the bath being well stirred, the cotton is dipped in the manner described in the operation referred to.

"The cotton, after being well dried, is dipped in a ley at three degrees.

"After the cotton has been well dried, it is dipped in a ley at four degrees.

"When the cotton is again dry, it is dipped in a ley at five degrees, and this concludes the dips After being dried, it is washed, galled, and alumed, with the same proportions, and attention to the same circumstances as in the ninth, tenth, and eleventh operations. The cotton has now received all the preparations necessary for taking the dye; and ought to be of the colour of the bark of a tree. A very essential circumstance to be attended to is, never to dip the cotton until it is perfectly dry, otherwise we run the risk of rendering

* Black and white galls in equal quantities.
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Processes of Dyeing.

Sixteenth operation.
The dyeing

the colour spotted. When the cotton has hung out upon the poles, it must be frequently shaken and turned, to make it dry uniformly.

"A copper of an oblong square form is generally employed, which ought to be capable of holding about one hundred gallons, in which quantity twenty-five pounds of cotton may be dyed at once. The process for dyeing is begun by filling the copper with water, within four or five inches of the brim, and pouring on a pint-full of bullack's blood, or what is still better, when it can be procured, sheep's blood, (this is equal to about five gallons,) and then adding the lizary (Smyrna Madder). When we wish to obtain a fine bright colour, which penetrates, and has a good body, we commonly mix several kinds of lizary together, as one pound and a half of lizary of Provence, with half a pound of lizary of Cyprus; or if these cannot be had, a pound of that of Provence, with as much of the lizary from Tripoli or Smyrna, allowing always two pounds for one of cotton. When the lizary is in the copper, it is stirred with the rake, to break the eddies or lumps, and when the bath is warm, the cotton is put in on skain sticks, two hanks commonly on each. Care must be taken to immerse it properly, and to turn the cotton on the skain sticks, by means of a pointed stick passed along them within the hanks. This process is continued for an hour; and when the copper begins to boil, the cotton is taken off the skain-sticks, and immersed in it, each hank being suspended, by means of a cord passed through it, to sticks supported over the copper. It is now taken out, and washed knot by knot at the river, wrung with the pin, and dried.

Seventeenth operation. Heightening.

"Soda ley at two degrees is poured into the copper used for scouring, which should hold a hundred and fifty gallons of water, and it is then filled within ten or twelve inches of the brim; four or five pounds of olive oil are then added, and six pounds of white Marseilles soap cut very small; it is kept stirring until the soap is dissolved, and when the copper begins to boil, the cotton is put in, a cord being previously passed through it, to prevent its being entangled. The copper is then covered up, and stopped with rags, loaded and made to boil gently for four or five hours; the cover being now taken off, the cotton should appear finished, and of a beautiful red. The cotton must not be taken out of the copper for ten or twelve hours, because it improves in the bath, and acquires a much greater degree of brightness. It must be well washed, knot by knot, and the operation is complete." See Berthollet, Elem. of Dyeing.

M. Papillon's process, with remarks by Dr Bancroft.

302. The following process, which has a considerable resemblance to the one we have just described, was long practised with great success at Glasgow, by M. Pierre Jacques Papillon, a native of France, and communicated to him by a generous reward to the Commissioners and Trustees for Manufactures in Scotland. By agreement, the process was kept a secret during a term of years, for the benefit of M. Papillon; that term having expired, the process was laid before the public in 1803. In describing the different steps of which it consists, we shall avail ourselves of some very judicious observations of Dr Bancroft, intended principally, he remarks, to explain its difference, where any occurs, with the correspondent operations generally practised at Rouen, as they have been lately published by M. Vitalis.

303. For 100 lbs. of cotton, take 100 lbs. of Alicant barilla, 20 lbs. of pearl ashes, 100 lbs. of quicklime; mix the barilla with soft water in a deep tub, having a small hole near its bottom, which is to be stopped at first with a peg, but covered within by a cloth supported by two bricks, in order that the ashes may be hindered from either running through the hole, or choking it while the ley filters through it. Under this tub another is to be placed to receive the ley; and pure water is to be repeatedly passed through the first tub, to form leys of different strength, which are to be kept separate until their strength has been examined. The strongest required for use must swim or float an egg, and is called the ley of six degrees of the French arco-meter. The weaker are afterwards brought to this strength, by passing them through fresh barilla; but a certain quantity of the weak, which is to mark two degrees of the instrument, must be reserved for dissolving the oil, the gum, and the salt, which are used in subsequent parts of the process. The ley of two degrees is called the weak barilla liquor, the other is called the strong.

Dissolve the pearl ashes in ten pails (containing four gallons each) of soft water, and the line in fourteen pails.

Let all the liquors stand until they become quite clear, and then mix ten pails each.

Boil the cotton in the mixture five hours, then wash it in running water, and then dry it.

Remark by Dr Bancroft: "At Rouen two courses of operations are practised to produce the Turkey red; one is called the grey course, and the other the yellow course. In the former, the cotton, after being alumed, receives no more oil, but goes to the dyeing vessel, retaining the grey colour, which naturally results from its being impregnated with alum and galls in combination. But in the yellow course, the cotton, after being alumed, is again immersed in the oleaginous mixtures or steeps, to be mentioned hereafter, by which it acquires a yellow colour. The grey course may consist either of fifteen steeps, or of nineteen, and the yellow of twenty. The first of these courses has most similarity to that of M. Papillon; and it is this which we shall principally compare with the latter, occasionally noticing any peculiarity in the yellow course.

At Rouen, the first or cleansing operation is performed with a very weak ley of soda containing half a degree of the arco-meter; employing about 150 gallons to 100 lbs. of cotton, which is to be boiled therein six hours, then drained, well rinsed in running water, and afterwards dried. This operation is intended to free the cotton from all impure or extraneous matter; but not to produce effects like those of bleaching, by exposure upon the grass, which, until lately, it was believed would lessen the durability of the colours to be subsequently dyed."

Take a sufficient quantity (ten pails) of the strong barilla water in a tub, and dissolve or dilute in it two balls of oil of vitriol, one pound of gum arabic, and one pound of sal ammoniac, both previously dissolved in a sufficient quantity of weak barilla water; and lastly, twenty-five pounds of olive oil, which has been previously dissolved, or well mixed with two pails of the weak barilla water.

The materials of this steep being mixed, tramp or tread down the cotton therein, until it is well soaked: Let it steep twenty-four hours, then wring it hard, and dry it.

Steep it again twenty-four hours, and again wring and dry it.

Steep it a third time twenty-four hours, after which wring and dry it; and lastly, wash it well, and dry it.
Remark by Dr Bancroft.—"The steep here prescribed, contains three ingredients not employed, so far as I can recollect, by any other person; and one of these, I mean the sulphuric acid, seems to indicate a want of chemical knowledge in M. Papillon; because, by neutralizing the soda, it must obstruct the effect which the latter is intended to produce, (that of rendering the oil miscible with water,) or at least, render a greater proportion of it necessary, in order to obtain that effect. In regard to the other two ingredients, viz. the gum and sal ammoniac, I shall only observe of the former, that the quantity is by much too small to produce any considerable effect, either good or bad, without offering any opinion of the latter, because I am unable to form even a conjecture, respecting the purpose which it may have been intended to answer. Did M. Papillon wish, by these additions, to give to his process some appearance of novelty or peculiarity which might render it more deserving of a reward? At Rouen, the *bain blis* is prepared by steeping twenty-five or thirty pounds of sheep's dung several days in a lea of soda, marking four degrees, which is to be afterwards diluted until it amounts to forty gallons; and the dung being squeezed, and broken by the hands, is afterwards made to pass with the liquor through the bottom of a copper pan, provided with numerous small holes or perforations, into a tub containing twelve pounds and a half of fat oil; and in this the oil and dung are, by sufficient stirring, to be well mixed with the ley, and with each other; and in this mixture, which contains but half the quantity of oil prescribed by M. Papillon, the cotton (100 lbs.) is to be steeped, &c. as directed by the latter. It is highly important after this, and each of the succeeding operations, that the cotton should be thoroughly and completely dried, by a stove heat; that of the open air, in this climate, not being sufficient, even in summer.

This part of the process is precisely the same with the last in every particular, except that the sheep's dung is omitted in the composition of the steep.

Remark by Dr Bancroft.—"At Rouen, this steep is prepared by mixing thirty-eight gallons of ley of soda with ten pounds of olive oil, and stirring them until the mixture becomes uniformly milky; which it will do without much difficulty, and remain so without any separation of the oil, if the quality of the latter be suited to this use; this they add to what may have been left of the former steep, and after mixing them promiscuously, they impregnate the cotton therewith, by the usual treatment; drying it after an interval of twelve hours, first in the open air, and afterwards by a stove heat. This steeping and subsequent drying must be repeated once, twice, or three times, according to circumstances, to be mentioned hereafter.

Between this white steep, and the following gall steep, it is the practice at Rouen to employ three salt steeps, and one cleansing operation. In the first, (called premier sel,) twenty-four gallons of the ley of soda, marking two and a half degrees, are mixed in a tub, with the remnant of the white steep; and with this the cotton is impregnated, and dried as in the former operations. In the next, (called second sel,) the remnant of the last steep is mixed with twenty-four gallons of the ley of soda, marking three degrees, and the cotton steeped therein, and dried as before. In the third, (called troisieme sel,) the remnant of the preceding steep is mixed with twenty-four gallons of the ley of soda, marking three and a half degrees; and with this the cotton is to be impregnated, and dried as before. The residuum of this steep, called silex, is preserved, to be used in the brightening operation.

In the cleansing operation, (called degraisage,) the cotton is steeped one hour in lukewarm water, then wrung by the hands, and afterwards washed in a stream of water, to remove any superfluous or uncombined oil, which, as is supposed, might obstruct the equal application and uniform effect of the following gall steep, and thereby render the colour when dyed unequal. After being so washed, the cotton is to be dried, first in the open air, and afterwards by a stove heat."

Boil twenty-five pounds of galls, bruised, in ten pails of river water, until four or five are boiled away; strain the liquor into a tub, and pour cold water on the galls in the strainer, to wash out of them all their tincture. As soon as the liquor is become milk-warm, dip the cotton into it hank by hank, handling it carefully all the time, and let it steep twenty-four hours; then wring it carefully and equally, and dry it well without washing.

Remark by Dr Bancroft: "This constitutes the eighth operation at Rouen, where, as well as in M. Papillon's process, galls in sorts seem to be now employed, though it was formerly thought by the dyers of Turkey red, (as several of them assured me,) that only the white galls, or those from which, at maturity, the insects had made their escape, were fit for this purpose; the others being supposed to give an injurious brown stain to the cotton. But probably it has been since found, that this stain is removed without any trouble by the subsequent brightening operation. At Rouen, the cotton, as soon as it has sufficiently imbibed the soluble part of the galls, and been very moderately wrung, is spread as expeditiously as possible in the open air, if the weather be dry, or if not, under cover; but the drying is always finished by a stove heat.

Dissolve twenty-five pounds of Roman alum in fourteen pails of warm water, without making it boil; skim the liquor well, and add two pails of strong barilla water, and then let it cool until it be lukewarm. Dip your cotton, and handle it hank by hank, and let it steep twenty-four hours; wring it equally, and dry it well without washing.

Remark by Dr Bancroft: "At Rouen, thirty or thirty-five pounds of the purest alum are commonly employed for this steep, with only seven pails of hot water; adding, when the alum has been dissolved, two gallons only of the lixivium, or ley of soda, marking four degrees. But when these proportions are employed, the cotton is not subjected to a second steep with alum, as directed in M. Papillon's sixth step. Sometimes, however, at Rouen, two steeps, with the aluminous mordants, are employed; and, in that case, twenty pounds of alum are dissolved for the first, and fifteen pounds for the second, leaving an interval of two days between them, during which the cotton should retain its moisture, after being slightly wrung from the first steep. It is, however, to be well dried before it goes into the second.

"This steep is performed in every particular like the last; but when the cotton is dry, steep it six hours in the river, and then wash and dry it again.

"The cotton is dyed in parcels of about ten pounds at once; for which take about two gallons and a half of Dyeing ox blood, and mix it in the copper, with twenty-eight pails of milk-warm water, which are to be well stirred; then add twenty-five pounds of madder, and stir the whole well together. Then having before hand put the ten pounds of cotton on sticks, dip into the liquor,
and move and turn it constantly one hour, during which gradually increase the heat, so that the liquor may begin to boil at the end of the hour. Then sink the cotton, and boil it gently one hour longer. And lastly, wash and dry it. Take out so much of the boiling liquor as will leave the remainder only milk warm, when mixed with as much fresh water as may be required to fill the copper again, and then proceed to make up a dyeing liquor, as before, for the next ten pounds of cotton; and so proceed in succession with the whole.

Remark by Dr Bancroft.—" At Rouen the cotton is dyed in parcels of twenty-five pounds each; and the dyeing vessel is of a quadrangular form, containing about 100 gallons of liquor. One quart of ox blood is employed for each pound of cotton, with two pounds of Provence madder, or one pound of the latter, with one pound of Smyrna madder. Some persons, however, think it best to effect the dyeing by two separate operations, employing half of the before-mentioned proportion of madder for one dyeing, and half for the other; but always taking care not to dry the cotton between the first and second dyeings. There are, moreover, some at Rouen who give cotton another alum steep between these dyeing operations, employing for that purpose half as much alum as was used for the first steep; and afterwards washing, &c. as usual.

Mix equal parts of the grey steep liquor, and of the white steep liquor, taking five or six pails each; tread down the cotton into this mixture, and let it steep six hours, then wring it moderately and equally, and dry it without washing.

Ten pounds of white soap must be dissolved carefully and completely, in sixteen or eighteen pails of warm water; because if any little bits of the soap remain undissolved, they will make spots on the cotton. Add to this four pails of strong barley water, and stir it well. Sink the cotton in this liquor, keeping it down with cross sticks, and cover it up; boil it gently two hours, when, being washed and dried, it will be finished.

Remark by Dr Bancroft.—" This constitutes the fourteenth operation in the first set of grey courses at Rouen; where, after having macerated the cotton with the siuon, they boil it five or six hours with six or eight pounds of white soap, previously dissolved in one hundred and forty-five gallons of water, and in a vessel covered at the top, so as to leave only a very small opening for the necessary escape of the steam, which might otherwise occasion an explosion. The effect of this ebulition with soap, is to dissolve and separate from the cotton all the yellowish brown part of the madder colour which may have been applied to it in the dyeing operation; and by this separation to change the colour from the dull brownish red, which it would otherwise retain, to a bright lively colour, nearly equal to that of the finest cochineal-scarlet. It is only by the singular degree of fixity which the pure red part of the madder acquires, in consequence of the operations just described, that this beautiful red can be obtained; for though the reds given from madder in calico-printing are sufficiently durable for all common uses, they are not fixed sufficiently to bear, without injury, that extent of boiling with soap, which is necessary to separate the yellowish brown part of the colour, and produce the pure vivid red, which results from the operations under consideration. Such, indeed, is the stability of the Turkey red, when well dyed, that some of the persons employed in dyeing it have assured me, that their colours would sustain boiling with soap for the space of thirty-six hours, without injury.

In addition to the steps or operations prescribed by M. Papillon, they employ another at Rouen, called rasage, which is intended to make the red incline more to the rose colour, and at the same time to increase its vivacity. For this operation, for the former quantity of cotton, (100 lbs.), they dissolve in one hundred and forty-five gallons of water, sixteen or eighteen pounds of white soap; and as soon as the liquor begins to boil, they add to it from a pound and a half to two pounds of the crystallized muriate of tin, previously dissolved in two quarts of water, and mixed with eight ounces of single aquafortis; and having equally dispersed this mixture through the boiling solution of soap, by stirring, &c. the cotton is put into it, and boiled with the same pretension as at the brightening operation, until the desired effect has been obtained, which is to be discovered by frequent examinations." See Phil. of Perm. Col. vol. ii. p. 249.

304. Pallis has given a detailed account of the method of dyeing the Turkey red, as it is practised by the Armenians, who had been forced, by the troubles in Persia, to take up their residence in Astracan. The limits which we have prescribed to ourselves, do not permit us to give the process in the author's own words; but the following brief outline will convey some information respecting it. The cotton to be dyed, after being well washed in running water, and dried, is alternately impregnated with fish oil, and exposed to the atmosphere for the space of seven days; the impregnation being performed during the night, and the dyeing during the day. They have ascertained, that other oils do not succeed; and, indeed, they do not use the oil of all fish indiscriminately, but choose that which becomes milky upon being mixed with an alkaline solution. After these repeated impregnations and exsications, they wash the cotton and dry it; they then give it an astrin- gent bath, to which a little alum is added; they dye it in a madder bath, with which calves blood has been mixed; and, finally, they digest it in a solution of soda. It appears, that much of the success of the process depends upon the alkaline bath: The cotton being thrown into it, the bath is made to boil over a steady fire till the colour acquires the proper tint. The workman watches with the utmost care for the moment when it is necessary to take out the stuff, and he will rather burn his hand than miss that opportunity.

305. Notwithstanding the numerous attempts which have been made to improve the Turkey red, and to ascertain the circumstances upon which its beauty and durability depend, the theory of the processes is still involved in much obscurity. The object of impregnating the cotton with oil, is doubtless to afford a ground to the stuff, by which its attraction for the colouring matter is to be increased; and yet the methods usually employed for giving this impregnation, do not seem the most effectual for the purpose. It order that the soda, which is mixed with the oil, may produce suitable effects, it must be used, it is said, in the caustic state, otherwise their combination will be imperfect, and the oil will be applied unequally to the cotton. Now, it is well known, that in this intimate state of union, a caustic alkali and oil form soap; and how the oil thus applied should attach itself to the stuff, we confess we cannot conceive; it is added, indeed, that the oil should be in excess, rather than in a state of absolute saturation with the soda, as it would otherwise abandon the cotton in the subsequent washings or rinsings.
sings without benefiting the dye. It appears to us, that a great part of the oil employed, uniting itself (as it must do) with the caustic soda, can operate merely as a detergent, and that it is only the excess which combines with the stuff, and affords a ground for the colouring matter. In the process followed at Astrakan, the oil is applied immediately to the cotton, without the intervention of an alkali; and at Masulipatam and Pulicat, where the reds are excellent, the cotton is soaked either in the oil of sesameum, or in melted hogs-lard; and being afterwards pressed, to free it from the superfluous oleaginous matter, it is exposed to the sun and air for some days: this operation is repeated three times, after which the cotton is well washed. We may conclude, from these facts, that the union of the soda with the oil is not absolutely essential to the impregnation of the stuff with the latter; and that the object in view may be attained by the direct application of a suitable quantity of oleaginous matter, the cotton having been previously well scoured and prepared for its reception.

506. We are not prepared to speak so decidedly with regard to the effects that may be produced by the dung, or the blood of ruminating animals; though Chaptal, Le Pileur d'Apligny, and Felix, have all given it as their opinion, that whatever effect these substances may have in heightening the vivacity of the colour, they do not at all contribute to its durability. Dr Bancroft has expressed his sentiments on this subject more cautiously and philosophically: After a great number of unsuccessful attempts, which he varied in every possible way, to produce the colour in question from oil, galls, and alum, he has concluded, that the gelatine contained in the dung of ruminating animals, or the albumen which it also affords in a much larger proportion, or some other matter derived from it, and probably from their blood, is essentially necessary to produce that fixity, as well as beauty of colour, for which the Turkey red is so much admired; though at present we only know with certainty of this matter, and this colour, that both may be communicated by the successive applications and operations which have been recently described, but of the particular effect of either we are in a great degree ignorant.” See Philosophy of Permanent Colours, vol. ii. p. 273.

507. The process of galling is attended with several advantages: The acid contained in the decoction of galls decomposes the saponaceous liquor with which the cotton is impregnated, and thus tends to fix the oil in the stuff, while the astringent principle unites with the oil, and forms a compound which is little soluble in water, and has a considerable affinity with the colouring principle of madder. The oil may also owe much of its fixity to its being mixed with the gelatinous matter derived from the dung, and the mixture being afterwards precipitated and attached to the cloth by the tannin of the galls. In confirmation of this opinion, it may be stated, that, by the common process of dyeing madder, red, the addition of a little glue is found to add greatly to the beauty of the colour. In short, were we to advance any theoretical opinion on a subject which is still involved in so much uncertainty, we would venture to offer as a conjecture, that the ultimate effect of the different steps of the process for dyeing Turkey red, previous to the alumming step, is impregnating the fibres of the bottom with a small portion of a leathery oleaginous matter.

508. The other ingredient which enters into the composition of the mordant for this celebrated colour, i.e., alum, which in this case operates in the usual manner, by heightening the madder-red, and giving fixity to the colouring matter. If the impregnation, which we have supposed, actually takes place, it will be easy to explain the increased affinity of the stuff for the aluminous mordant, as well as the superior brilliancy which the latter communicates to the colouring matter. The stuff, partaking of the nature of animal substances, by reason of the operations to which it has been subjected, must possess similar properties with respect to colouring matters, and absorb the dye with corresponding lustre and effect.

309. The mordant composed of these different substances, is undoubtedly the most complicated of any which is employed in dyeing; and it still deserves to be investigated with attention. “It is only from a great degree of precision,” says Chaptal, “in this combination, and a great portion of judgment in the artist who produces it, that a beautiful colour can be expected; but though it be possible for him to conduct himself without error, through the labyrinth of these numerous operations, by taking the clue of experiment as his guide, he will find it very difficult to simplify his progress, or bring it much nearer to perfection. It is only by reasoning on his operations, and calculating the result, as well as the principle of each, that he can hope to become master of his processes, to correct their faults, and to obtain invariable products. Without this, the practice of the most experienced artist will afford nothing in his hands, but the discouraging alternative of success and disappointment.”

CHAP. III.

Processes for Dyeing Yellow.

310. A yellow colouring matter, possessing different degrees of brightness, is afforded by a great variety of substances; but under all its modifications, it has a very slight affinity for stuffs, and must be fixed by the intervention of mordants. The substances from which yellows are usually extracted, are weld, rhiz cotinus or fuscit, sumach, anotta, dyer’s broom, turmeric, and quercitrin: of these, the most important are weld and quercitrin.

1. Processes for Dyeing Wool Yellow.

311. The yellow communicated to wool by weld, has little durability, unless the stuff be previously impregnated with some mordant. Alum and tartar are accordingly employed, and by their means wool acquires from that plant a beautiful and permanent yellow.

312. For the boiling, which is managed in the usual way, Hellot directs four ounces of alum to every pound of wool, and only one ounce of tartar; though many dyers use them in equal quantities. In preparing the weld bath, the plant is inclosed in a bag of thin linen, and prevented from rising in the boiler, by means of a heavy wooden cross. Some boil it till it sinks to the bottom, and keep it there by a cross, while others take it out with a rake, and throw it away.

313. Hellot recommends five or six pounds of weld of every pound of cloth; but the quantity must be proportional to the depth of shade required. Lighter and brighter shades may be obtained by dyeing after deeper ones, water being added at each dipping, and the bath kept boiling; but light shades procured in this
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318. When a deeper and more permanent colour is to be given, the stuff should be boiled in the ordinary way, but without either tartar or argol, for the space of an hour, or an hour and a quarter, with about one-sixth or one-eighth of its weight of alum dissolved in a suitable quantity of water; it should then be immersed without being rinsed, with about as many pounds of powdered bark as there were used of alum to prepare the stuff, and turned as usual through the boiling liquor, till it assumes the proper shade. About one pound of clean powdered chalk for every hundred pounds of wool, may then be mixed with the bath, and the boiling continued eight or ten minutes longer, when the yellow will have become both higher and brighter.

319. Woollen stuffs may be dyed of a beautiful orange yellow, by the following process. For every hundred pounds of wool or cloth, take ten pounds of quercitron, and an equal weight of the murio-sulphate of tin; let the bark, in the state of powder, and inclosed in a bag, be first introduced into the dyeing vessel, with hot water; six or eight minutes after, add the murio-sulphate of tin to the bath, and stir the whole well for two or three minutes; after which the cloth is put into the dyeing liquor, and turned briskly for a few minutes. The colouring matter attaches itself so quickly, and at the same time so uniformly to the cloth, that after the commencement of the boiling, the highest yellow may be communicated in less than fifteen minutes, without the smallest danger of its being uneven.

320. When a very bright golden yellow approaching less to the orange is wanted, Dr Bancroft recommends seven or eight pounds of murio-sulphate of tin, with about five pounds of alum, and ten pounds of bark for every hundred pounds of cloth. The bark is first boiled a few minutes, then the murio-sulphate of tin with the alum is added; after which the cloth is dyed, as already directed. By using smaller proportions of the ingredients, pure bright yellows of less body may be obtained, having every variety of shade.

321. Yellows of a delicate greenish tinge may be Greeneish obtained, by employing, in addition to these ingredients, a quantity of tartar. Thus, for a full bright yellow, delicately inclining to the greenish tinge, Dr Bancroft advises eight pounds of bark and six pounds of murio-sulphate of tin, with six pounds of alum, and four of cream of tartar. A little more alum and tartar will render the yellow more delicate, and give it more of the greenish tinge; and when this clean, lively, delicate greenish tinge is desired in the utmost perfection, he recommends these different ingredients to be employed in equal quantity. As these very delicate shades are not required to possess much fulness or body, ten pounds of bark, and the like quantities of murio-sulphate of tin, alum, and tartar, are quite sufficient for dyeing three or four hundred pounds weight of stuffs.

322. In order to dye these very pale greenish shades with exquisite delicacy and beauty, Dr Bancroft recommends to boil the bark with a small proportion of water in a separate tin vessel for the space of six or eight minutes, then to add the murio-sulphate of tin, alum, and tartar, and boil them altogether about fifteen minutes; and afterwards put a little of this yellow liquor into a dyeing vessel, previously supplied with water sufficiently heated. The mixture being properly stirred, the cloth is introduced into it, and dyed as usual; fresh supplies of the yellow liquor being added as it is needed. In this way, the palest and most delicate shades may always be dyed with ease and certainty; and those who have never seen the effects of this process, will hardly, in Dr Bancroft's opinion, conceive the exquisite beauty and delicacy of these pale, but lively, greenish lemon yellows.

323. The colours obtained by these means from Durability quercitron are extremely durable; and are found to resist even the action of strong mineral acids, and of boiling soap-suds, as well as exposure to the air. They last they are enabled to withstand by the good effects of the alum, and more especially of tartar.

324. By employing very small proportions of cochineal with quercitron, and the mordants used in the processes already mentioned, the colour is exalted to a beautiful orange, and even to an aurora. Madder produces the same effect when used with quercitron, but in an inferior degree.
II. Processes for Dyeing Silk Yellow.

325. Before the introduction of quercitron bark, weld was almost the only colouring matter employed for dyeing silk of a plain yellow. The silk to be dyed ought to be previously scoured with soap, in the proportion of twenty pounds of soap to the hundred of stuff, and afterwards alumed, and refreshed or washed after the aluming.

Weld bath.

326. The bath is prepared with two pounds of weld for each pound of silk, and after boiling a quarter of an hour, is passed through a sieve or cloth into a vat. When the temperature is such as the hand can bear, the silk is put in, and turned until the colour is become uniform. In the meantime, the weld is exposed to a second boiling in fresh water; and half the first bath being removed, its place is supplied by a fresh decocction. This bath may be used a little hotter than the first, but care must be taken not to allow it to be so warm as to dissolve any part of the colour already fixed. The silk is turned as before; and in the meantime, a quantity of soda is to be dissolved in a part of the second decoction. After being turned a few minutes, a bank is wrung with the pin, to ascertain if the colour is sufficiently full, and has the proper golden cast; if not, a little more of the alkaline solution is added, until the silk attains the desired shade.

Golden and jonquille yellows.

327. When we wish to produce yellows, with more of a gold or jonquille colour, a quantity of annotta, proportioned to the shade required, is added to the weld bath, along with the silk. If the lighter shades are to be given, such as pale lemon, or canary-bird colour, the silk must be previously well scoured, as the beauty will depend greatly upon the whiteness of the ground to which they are applied. The strength of the bath is regulated by the shade required; and if it be intended that the colour should have a greenish tinge, a little indigo is added to the bath; but this will be unnecessary if the silk has been previously azured. For these lighter shades, a smaller proportion of alum should be used.

328. Scheffer directs, that the silk should be soaked twenty-four hours in a solution of tin, made with four parts of nitric acid, one of common salt, and one of tin, and saturated with tartar; that it should be washed, and then boiled half an hour with an equal quantity of weld flowers. He says, that a fine straw colour is thus obtained, which possesses the advantage of resisting the action of acids. By following this process, says Berthollet, very little tin should be left in the solution, because the acid of tartar precipitates it.

329. "All the different shades of yellow," says Dr Bancroft, "may be obtained with equal facility and beauty, and more cheaply, by employing the bark (quercitron) in its stead, after the rate of from one or two pounds for every twelve pounds of silk, according to the particular shade of colour wanted. For this purpose, the bark, powdered and tied up in a bag, should be put into the dyeing vessel whilst the water is cold; and as soon as it becomes a little more than blood warm, the silk, previously alumed, should also be put in and dyed as usual; and when the higher yellows are wanted, a little chalk or pearl ashes may be added towards the end of the operation, as mentioned for the dyeing of wool.

Lively yellows.

330. "Where shades of yellow, more lively than any which can be given, either by weld or bark, with the aluminous basis only, are wanted, it will be advantageous to employ a little of the muri-sulphate of tin; and but a little of it, because the calx of tin, unless sparingly used, always diminishes the glossiness of silk. To produce the shades in question, it will be sufficient to boil, after the rate of four pounds of bark, with three pounds of alum, and two pounds of muri-sulphate of tin, in a suitable quantity of water, for ten or twelve minutes; and the heat of the liquor being afterwards reduced, so that the hand can bear it, the silk is to be put in and dyed as usual, until it has acquired the proper shade, (which it will do speedily,) taking care, however, to agitate the liquor constantly, that the colouring matter, which would otherwise subside in a considerable degree, may be kept equally dispersed through the liquor." See Phil. of Perm. Col. vol. ii. p. 146.

331. An aurora colour may be communicated to silk by annotta. The silk to be dyed is previously well scoured, with twenty pounds of soap to the hundred of stuff, and then immersed in a bath of water, to which more or less of the alkaline solution of annotta has been added, according to the shade required. The heat of the bath ought to be between that of tepid and boiling water. After the silk has acquired a uniform colour, one of the hanks must be taken out, washed, and wrung, to ascertain the state of the colour; if it is not sufficiently deep, more solution of annotta must be added, and the silk again turned. When the desired shade has been obtained, the silk is well washed, and bated twice by a stream of water, to free it from the superfluous colouring matter, which would only injure the beauty of the colour. The colour thus communicated may be rendered orange, by reddening the silks with vinegar, alum, or lemon juice. The acid saturates the alkali employed in dissolving the colouring matter of annotta, and destroys the yellow shade which the alkali had imparted, while it restores the natural colour of the annotta, which inclines a good deal to red.

332. A yellow of great brightness, but little durability, may be dyed upon silk by turmeric. Two processes are recommended by Guillac, which appear to be in substance the same. The first consists in aluming in the cold for twelve hours, a pound of silk in a solution of two ounces of alum, and dyeing it hot, but without boiling, in a bath composed of two ounces of turmeric, and a quart of aceto-citric acid, mixed with three quarts of water; by the second process, the colouring matter of the turmeric is extracted by aceto-citric acid, and the silk alumed, isdyed, either cold, or only moderately warm.

III. Processes for Dyeing Cotton and Linen Yellow.

333. Cotton is prepared for the yellow dye by previously scouring it with a ley composed of the ashes of the stuffs, green wood; it is then washed, dried, and alumed with one-fourth of its weight of alum; after twenty-four hours it is taken out of the aluming and dried without being washed. A weld bath is then prepared, in the proportion of a pound and a quarter of weld for each pound of cotton, into which the cotton is immersed and wrought in it till it acquires the proper shade. It is then taken out, and soaked for an hour and a half in a solution of sulphate of copper or blue vitriol, in the proportion of one-fourth the weight of the cotton. Lastly, it is thrown, without being washed, into a boiling solution of white soap made with the same proportions; and after being duly stirred and boiled in it for nearly an hour, it is well washed and dried.

334. When a deeper yellow is required, the cotton Deep yellow is not alumed, but two pounds and a half of weld are low.
employed for each pound of cotton, to which a dram of verdigris, mixed with a part of the bath, is added. The cotton is dipped and wrought in this bath until it has acquired an uniform colour; it is then taken out that a little ley of soda may be added; after which it is returned into the bath, and kept there for a full quarter of an hour, when it is taken out, wrung, and dried.

335. Lemon colour is dyed by the same process, with this difference, that only one pound of weld is employed for each pound of cotton, and that the proportion of verdigris is diminished, or even entirely omitted, and alum substituted in its stead. The shades of yellow may thus be varied in many different ways.

336. A more vivid and lasting yellow may be given to cotton by the following cheap process, recommended by Dr Bancroft. Take a sufficient quantity of the acetate of alumine, formed by dissolving after the rate of one pound of sugar of lead and three pounds of alum, and the cotton or linen being properly cleansed, immerse it in this mordant, (which ought to be about blood-warm,) for the space of two hours; let it then be taken out and moderately pressed or squeezed over a proper vessel, to prevent the unnecessary waste of the mordant; this being done, let it be well dried in a stove heat, where it can be conveniently applied, and then soaked again in the aluminous mordant; it is then taken out, and again pressed or squeezed as before, after which, without being rinsed, it is thoroughly wetted in as much, and only as much, lime water as will conveniently suffice for that purpose, and afterwards dried. If a very full, bright, and durable yellow be wanted, it may be proper to soak the stuff a third time in the diluted aluminous mordant, and after drying, wet it a second time with lime-water, and dry it again; but in either case, the cotton or linen, after its last immersion, should be well rinsed in clear water, to separate the uncombined particles of the mordant, which are always injurious in the dyeing bath. The lime water produces a more copious deposition of the alumine upon the stuff, while, at the same time, it leaves a portion of calcareous matter united with the mordant, a circumstance of considerable utility for the subsequent raising of the colour.

337. The bath is prepared by taking the quercitron bark powdered, and inclosed in a linen bag, at the rate of from twelve to eighteen pounds for every hundred pounds weight of cloth, and putting it into the dyeing vessel, containing a suitable quantity of cold water; a small fire is then lighted, and immediately after the cotton or linen is introduced and turned for the space of an hour or longer, during which the water should gradually become warmer, but never warmer than the hand can bear. At the end of the time mentioned, the fire may be gradually increased until the liquor begins to boil, after which the stuff may be allowed to remain in it for a few minutes only, because longer boiling always renders the colour of a brownish cast. The linen or cotton having thus acquired the proper shade of colour, is taken out, rinsed, and dried as usual.

338. "All the different shades of yellow," says Dr Bancroft, "may in this way be dyed from quercitron bark. If it be used sparingly with a very moderate heat, and the operation continued only for about half an hour, a pale, though lively yellow, will result; if used more copiously, and the operation continued somewhat longer, a fuller colour will be produced; and this may be raised higher and higher, according as the heat and proportion of bark are increased, and the dyeing operation prolonged, so as indeed to produce a very dark brownish yellow, if the liquor be made to boil for half an hour." See Phil. of Term. Col. ii. 155.

CHAP. IV.

Processes for Dyeing Blue.

339. The substances which are employed for dyeing blue are few in number. The only vegetable products used for this purpose being indigo and woad; Prussian blue being scarcely ever employed as a dye. Vegetables yield by solution a carbon of a very fine blue; and it seems probable, that when the blue colour is obtained by fermentation, as is the case with indigo, the carbonaceous matter is nearly set free, and remains combined with an oil, which gives additional fixity to the colour, and indicates the most suitable solvent.

1. Processes for Dyeing Wool Blue.

340. Various methods are employed for dyeing blue by means of indigo. To enter into a minute detail of these would be foreign to the object of this Work; and we must, therefore, restrict ourselves to a general view of such processes as appear to be best. The bath for dyeing blue is not prepared, as for other colours, in a copper, but in a wooden vat, which is sunk into the ground so as to be only breast high above it; and as it is of great consequence to preserve the heat of the bath, the vat is placed in a situation where it is least apt to cool.

341. Blue may be dyed with pastel or woad, which Pastel or gives a permanent but not deep blue; but if indigo be mixed with them, vats will be obtained very rich in colour; and indeed these are almost the only ones used for wool or woollen stuffs. They are called pastel or woad vats, to distinguish them from those in which indigo alone is used.

342. The celebrated woody vat, so generally employed for dyeing blue, is more complicated than any we have hitherto mentioned. The operations which are employed in different manufactories vary a good deal from one another; we shall select the description of one, which, in the opinion of Chaptal, is the most perfect of any with which, in the course of his extensive experience, he was acquainted.

343. Four hundred pounds of wood, well divided, Preparatio are put into a vat seven feet in depth by five feet in of a woody var. diameter. Thirty pounds of wood are then put into a caldron, to which, after three hours boiling, are added twenty pounds of madder and an equal quantity of bran. The ebullition is afterwards continued for half an hour, when the bath is recruited with twenty buckets of water. The wood is then withdrawn, and the bath allowed to become clear, after which it is returned into the vat. The bath is then raked or stirred for half an hour, after which the vat is covered, and at the end of six hours again raked during another half hour. This operation is repeated at the end of every three hours. When blue streaks make their appearance on the surface of the liquid, eight or nine pounds of quickline are mixed with it, which the workmen term giving bottom to the vat. They also introduce, at the same time, indigo triturated with water, which is used in the proportion of from 10 lbs. to 30 lbs. according to the shade of colour required. The raking is continued at the intervals prescribed, until the blue froth, already mentioned, be formed on the surface of the liquor, after which it begins to work. The vat is then
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When the bath is used either in too great or in too small a proportion, it occasions two very troublesome consequences. In the first case, the colour becomes black, the colour is putrid, and the stuff immersed in the bath comes out of a pale grey colour; in the second, the colour becomes rusty, the matter at the bottom is raised up, the smell is fetid, and, in short, a state of putrefaction has commenced.

The first state of the vat is corrected by adding to the liquor madder, bran, urine, tartar, &c.; by reheating the bath; by leaving it at rest without being raked, and by throwing into it a basketful or two of fresh wood. The putrefactive state is corrected by the addition of lime; by frequent raking, &c.

When cloth is to be dyed in a woad vat, the bath is stirred about two hours before the immersion of the stuff; and to prevent the latter coming in contact with the sediment at the bottom of the vat, it is supported by a netting, stretched upon iron or copper hoops, which are fastened with cords to hooks on the sides of the vat. When wool is to be dyed, another netting is put over it, to keep it under the surface of the bath. By means of this apparatus, the stuff, previously wrung out of tepid water, is introduced into the vat, and kept there a longer or a shorter time, according to the degree of strength wished to be given to it. After being taken out, it is wrung above the dyeing vessel, and exposed to the air, when the green colour which it had imbibed in the bath is instantly changed into a blue, by the absorption of the oxygen of the atmosphere. In a rich bath, it is difficult to give an uniform colour to light blues: The best method of obtaining such shades, therefore, is to use vats already exhausted, and which are beginning to grow cold.

That none of the indigo adhering to it may be lost, the stuff is first rinsed in a tub; it is then put through running water, and dried in the shade. When the colour is dull and muddy, the stuff is passed through boiling water, in order to free it from any extraneous impregnation. Stuffs which are of a very deep blue, ought even to be carefully cleansed by filling them with soap, which will tend to equalize the shade without affecting the colour.

A vat in which indigo alone is employed, without either pastel or woad, is called an indigo vat. The vessel used in preparing it is a copper, which being of a conical shape, leaves between it and the surrounding brick-work a sufficient space for containing the fire. Into this copper is poured about forty buckets of water, (more or less, according to its capacity,) in which have been boiled six pounds of salt, tartar or potash, twelve ounces of madder, and six pounds of bran. The whole of this mixture, ground and all, is put into the vat; six pounds of indigo, ground in water, are then to be put in, and, after raking carefully, the vat is to be covered, a slow fire being kept up round it. Twelve hours after it has been filled, it is to be raked a second time; and so on every twelve hours, till the liquor becomes blue, which happens in about forty-eight hours. If the bath has been well managed, it will then be of a fine green, covered with coppery coloured scales, and a blue scum or flower. The theory of the process for preparing this bath is the same as for the preceding, the principal difference consisting in the indigo being dissolved by means of an alkali instead of lime. The dyeing process is conducted with it in the same manner.

Hellot has described two indigo vats, in which the colouring matter is dissolved by means of urine. A quantity of madder is added to both; and in the one vinegar, in the other alum and tartar, of each a weight equal to that of the indigo. The quality of urine must be considerable. Berthollet thinks it probable, that the indigo, deprived of its oxygen by the urine and madder in a state of fermentation, is dissolved by the amoniac which is formed in the urine, either by the action of the heat, or the putrefactive process. These vats, it must be remarked, are by no means comparable with that of pastel, or that of indigo already described, much less work being expended by them, so that they are adapted only to small dye-houses.

Another preparation for dyeing blue with indigo is obtained by dissolving it in sulphuric acid. The resulting compound, which we shall call the sulphate of indigo, was first applied to the purposes of dyeing at Grosheain in Saxony, and hence the dye which it affords is usually known by the name of "Saxon blue." It is also sometimes called the chemical blue of Perner.

Bergman made many experiments, with the view of ascertaining the best method of dissolving indigo in sulphuric acid, and applying it in that state as a dye. From these he concluded, that if the sulphate of indigo has hitherto afforded a dye of little permanency, it was entirely owing to the acid being used in too diluted a state. He accordingly used the sulphuric acid in a very concentrated state, putting one part of indigo, finely powdered, into eight parts of the acid, of the specific gravity 1.9. The mixture was made in a glass vessel slightly stopped, and was accompanied with a considerable heat. After a digestion of twenty-four hours in a heat of 30 or 40 degrees, (from 80° to 104° of Fahrenheit,) the indigo was dissolved, and formed an opaque black solution. By the gradual addition of water, the intensity of colour was reduced, and exhibited in succession every shade of blue. In several experiments described by that illustrious chemist, he kept the stuff to be dyed twenty-four hours in boiling water, and then put a given weight of it into the bath, more or less strong, till the colour of the bath was exhausted. From these experiments he ascertained, that one part of indigo would, in this way, produce a deep blue on two hundred and sixty parts of stuff, which appeared to be then saturated with the colouring matter.

This blue penetrates into stuffs with difficulty; and in order to obviate this inconvenience, Quatremere and Perner have recommended an addition of potash to the acid. The alkali renders the colour more lively, full, and penetrating. A mixture of two parts of indigo in a solution of one part of potash will dye a cloth perfectly. The mixture is to be stirred for some time. After having stood twenty-four hours, one part of good dry potash in fine powder is added; the whole is again well stirred, and, having stood twenty-four hours longer, more or less water is gradually added. Instead of potash, Dr Bancroft has used clean chalk, and sometimes even in such quantities as to saturate the acid. The indigo was then precipitated with the chalk, and being collected in a solid mass, it was found to be still capable of dyeing a blue on wool, though it
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Acids for was and one and will be but two. The process of dyeing with Saxon blue is also introduced. By one and the other; dry it; work it again; and in short, use every means which his ingenuity can suggest for rendering the colour uniform. The stuff should always be washed and beetled between the dryings, and in every dip introduced into the bath in a wet state. After the proper colour has been obtained, it is dried on the tenters in the open air, either in the sun or the shade.

Prussian blue.

In the history of colouring matters, the allusions to Prussian blue are numerous, and have been made to dye cloths by means of Prussian blue. We shall now describe some of the processes which have been proposed for this purpose. Two methods have been suggested by Macquer, neither of which can be said to be attended with the desired effect. In one he soaked the stuffs in a solution of alum and sulphate of iron, and then in a diluted prussiate of potash, containing an excess of prussic acid; and lastly, in water acidulated with sulphuric acid, to dissolve that portion of the oxide of iron not combined with the prussic acid, which the uncombined alkali had precipitated. By repeating successively these immersions, he at last obtained a fine blue, but very unequal; while the stuffs, by the action of the sulphuric acid and the alkali, had become harsh to the touch. It is easy to see, that this process could not succeed. For, as Berthollet remarks, since an alkali not saturated with prussic acid was used in the second immersion, that part of the alkali which was not saturated must dissolve more or less of the blue taken up in the first. If any one, therefore, should repeat these experiments, he ought to employ an alkali saturated with prussic acid, or perhaps lime water, or rather magnesia, both of which have the property of combining with that acid.

Another process.

In Macquer's second process, the stuffs to be dyed were boiled in a solution of alum and tartar, and afterwards in water containing Prussian blue, diffused through it in a finely powdered state. They were now dyed uniformly, but the colour was faint, and seemed merely to be united mechanically with the fibres of the stuffs.

Process of Macquer.

Roland de la Platriere has published an account of another method of dyeing with Prussian blue, which in many respects has a considerable resemblance to Macquer's second process. On fine Prussian blue, in the proportion of a pound to a piece of stuff, powdered and passed through a very fine sieve, he poured in a vessel of delft ware as much muriatic acid as reduced it to the consistency of a syrup. The mixture, which immediately began to ferment, was well stirred for about half an hour; it was then considerably diluted with water, and stirred every hour for a day, till the fermentation ceased, and the particles of the Prussian blue, in a state of very minute division, were intimately united with the acid. Into a trough, narrower than those usually employed, but widening more towards the top, being two feet and a half high, two feet and a half diameter at top, and two feet at bottom, seven or eight buckets of water were poured for one piece of stuff. The colouring composition, well diluted with water in a separate vessel, was then added, by pouring it into the bath through a very fine sieve. When the stuff was placed on the winch over the trough, the bath was briskly agitated, and at the same time the stuff was let down quickly into the bath, and worked as fast as possible for two or three hours. As the Prussian blue is only in a state of mechanical solution, the particles are very apt to be unequally deposited upon the stuff, and it therefore requires the utmost attention on the part of the workman to prevent this taking place. He must work and rework the stuff; wash those parts which may have taken too deep a shade in the bath itself; work it over again, now one end first, then the other; dry it; work it again; and in short, use every means which his ingenuity can suggest for rendering the colour uniform. The stuff should always be washed and beetled between the dryings, and in every dip introduced into the bath in a wet state. After the proper colour has been obtained, it is dried on the tenters in the open air, either in the sun or the shade.

Dr Bancroft has also proposed a method of dyeing with Prussian blue, which does not seem to labour under the disadvantages hitherto attending its use as a dye. By reflecting that the inequality of colour to which the dyeing with this substance is liable, was probably owing to the difficulty of applying the ferruginous basis equally to all the fibres of the stuff; he boiled up what he conceived to be suitable proportions of sulphate of iron with quercitin bark, fusill, and logwood, separately, (these vegetable dyeing drugs having been chosen, not on account of their colours, but their cheapness,) and applied the oxide of iron in this state of combination to the cloth, which by this means appeared to have imbied it uniformly. He then immersed it in warm diluted prussiate of potash, neutralized by sulphuric acid, when the stuff became beautifully blue; and though he admits there were some inequalities in the colour of one of the pieces, he ascribed it rather to his own want of attention to the proper stirring and management of the dyeing liquor, and of the cloth, than to any unavoidable difficulty in giving evenness to the dye. The Prussian colouring matter must be used in a moderate heat, otherwise it will be precipitated by the sulphuric acid, and rendered unfit for the purpose, unless dissolved again by potash, lime, &c.

The colour produced by these processes is one of the most beautiful obtained in dyeing, and suffers no change by exposure to the air in all its vicissitudes. Roland de la Platriere left patterns of it in the open air for six months together. For a long time the colour gained in vivacity, and at last lost but little. Acids are not injurious to it; and boiling with alum even produces in it but little alteration. Dust, however, and rubbing on the creases of it, soon tarnish it; and it is instantly affected by the slightest touch of an alkali.

II. Processes for Dyeing Silk Blue.

Silk is dried blue, by employing the indigo vat. (348.) already described. Sometimes a larger proportion of indigo is employed than is there directed, but nearly the same quantities of bran and madder. Macquer states, that if half a pound of madder be employed for every pound of salt of tartar or potash, the vat becomes greener, and its colour is more fixed in the silk, without being of a less pleasing cast. The pastel or woad vat is not used for dyeing silk, because it does not readily impart to it a sufficiency of colour. When
the bath has undergone its usual course, it is refreshed with about two pounds of potash, and three or four ounces of madder; it is then raked; and in four hours it is fit for boiling.

360. Before being immersed in the bath, the silk is boiled with soap, in the proportion of thirty pounds of the latter for every hundred pounds of the former; and afterwards well cleansed from it by two or more beatings at the river. As silk is apt to take the dye unequally, it is necessary to dye it in small portions, one hank being dipped at a time, by applying it to a wooden cylinder, and turning it once or oftener in the bath. It is then well wrung and aired, to change the green colour to a blue. When it has assumed the proper shade of colour, it is thrown into clear water, and then wrung repeatedly with the pin. Lastly, it is dried as speedily as possible. In winter, and in damp weather, it should be dried in a chamber heated by a stove, and hung upon a frame kept constantly in motion.

361. When it is required to give silk a deep blue, indigo alone is insufficient for the purpose; it must first receive a ground from some other colouring matter. For the Turkey blue, which is the deepest, the silk must be prepared in a strong bath of archil; and, for the Royal blue, one of the same kind, but weaker. A blue, equal in depthness to the royal blue, may be given by employing cochineal instead of archil.

362. A blue of little durability is communicated to silk by means of verdigris and logwood. Bertollet says, that this dye might be rendered more lasting, by first giving it a lighter shade than is intended, in a bath of this kind, afterwards dipping it in an archil bath, and, lastly, in the indigo vat.

363. To dye raw silk blue, which is naturally white should be chosen. It ought to be thoroughly soaked in water, and afterwards put into the vat in separate hanks, as already mentioned with respect to scoured silk. If raw silk is to be dyed of the deeper shades of blue, it must also be treated in the same manner. The mode of applying the Prussian blue to silk is the same as the process already described for dyeing it upon wool: in both cases, the dye is very feebly united with the stuff.

III. Processes for Dyeing Cotton and Linen Blue.

364. The vat for dyeing cotton and linen blue, is, according to Pileur d'Apligny, a cask containing about 120 gallons. The quantity of indigo used is generally from six to eight pounds, which, after being pounded, is boiled in a ley, drawn off clear from a quantity of lime equal to the indigo, and double its weight of potash. The boiling is continued till the indigo is thoroughly penetrated by the ley, carefully stirring it all the while, to prevent the indigo adhering to the bottom, and being burnt.

365. Whilst the indigo is boiling, an equal weight of quicklime is slaked; about twenty quarts of warm water are added, and in this is dissolved as much green vitriol or sulphate of iron, as is equal to twice the weight of the lime. When the solution is completed, the liquor is to be poured into the vat, which must be previously half filled with water. To this the solution of the indigo must be added, with the remainder of the ley not used in boiling it. When all these are put into the vat, it is filled up to within two or three fingers of the brim, and stirred with the rake two or three times a-day, till it is in a state fit for dyeing, which it will be in about forty-eight hours, sometimes sooner, according to the temperature of the atmosphere.

366. A simpler process is followed at Rouen, which is thus described by Quatremer. "The vats are constructed of a kind of flint, covered, within and without, with a coating of fine cement. Every dye-house is furnished with a certain number of these, arranged in parallel lines. Each vat is capable of containing four hogsheads of water, and into it may be put eighteen or twenty pounds of indigo. The indigo having been macerated for a week in a caustic ley sufficiently strong to bear an egg, and then ground in a mill, in which not unfrequently the maceration is made, about three hogsheads and a half of water are put into the vat, and afterwards twenty pounds of lime. When the lime is thoroughly slaked, the vat is raked, and thirty-six pounds of sulphate of iron are put in. When the solution is completed, the ground indigo is poured through a sieve. On that day it is raked seven or eight times; and, after having stood at rest six-and-thirty hours, it is fit for dyeing.

367. In dyeing-establishments upon a large scale, vats are set or prepared at different times. The cotton or thread is first dipped in the bath which has been previously most exhausted; and then carried from vat to vat, till it attains the proper shade. It ought to be wetted before it is put into the first vat, and should not be left in the bath more than five minutes, as, in that time, it imbibs all the colouring matter it can take up. As soon as the dyeing in one vat is finished, the bath should be raked, and not used again till it has stood at least twenty-four hours; but if it has been freshly prepared, it need not stand so long.

368. When a vat has been used three or four times, it begins to change; no more veins appear on the surface after raking, or it becomes black. It must then be refreshed; and, for this purpose, four pounds of sulphate of iron, with two of quicklime, are added, and it is raked twice. A vat may thus be refreshed three or four times, diminishing the ingredients each time, as it declines in strength and quality.

369. Haussman describes a bath in which a much smaller proportion of indigo is employed. For three thousand pounds of water, he takes thirty-six pounds of quicklime, which he slakes in two hundred pounds of water; with this he mixes the indigo, well ground: in it dissolves thirty pounds of sulphate of iron in a hundred-and-twenty pounds of hot water; and, having left the whole at rest for a quarter of an hour, he finishes the filling of the vat, gently stirring it, without intermission. The blue vat, he observes, may be made at discretion, by varying the quantity of indigo. From twelve to twenty pounds may be taken for the quantity of water above directed, or even more, if a colour like that of indigo in substance be required, particularly when it is for dyeing linen. When the vat begins to grow turbid, dyeing in it must be discontinued; it must then be stirred, and left till the liquor above the sediment become clear. If the lime ceases to operate, from being saturated with carbone acid, a fresh portion of it must be added after being slaked in a sufficient quantity of water. If the iron be too much oxidated to act on the indigo, sulphate of iron is to be added, always taking care that there be more lime than is necessary to saturate the sulphuric acid, the excess being necessary to dissolve the indigo. When the indigo is exhausted, all that is requisite, is to add a fresh portion ground in water, to stir the vat repeatedly, and
Processes of Dyeing.

By observing these precautions, M. Haussmann preserved the same vat in a state fit for dyeing during two years; and he might have kept it still longer, had it not been for the accumulation of sediment, which at last rendered it impracticable to dip the stuffs sufficiently deep in the bath.

Bergman mentions another vat, which answers very well for dyeing thread or cotton. The following is the process, as described by Scheffer: To very strong soap-boiler's ley, indigo well powdered is added, in the proportion of three drachms to a quart; and after five minutes, when the colouring matter is well penetrated by the ley, six drams of powdered orpiment are added. The bath is then well raked. In a few minutes it becomes green, and exhibits the blue flower at the top, when the fire is extinguished, and the dyeing process begun.

371. Cotton and linen take very pale shades from Saxon blue; but Prussian blue may be applied more successfully to these stuffs, by the processes already described, than to wool or silk.

CHAP. V.

Processes for Dyeing Compound Colours.

372. Compound colours, in dyeing, are such as are formed from various modifications of the simple colours, whether by admixture or superinduction. If the processes by which these modifications are effected were of a mechanical nature, the resulting colour arising from the combination of particular colours might be pretty accurately determined; but the chemical action of the morant, employed in dyeing one colour, exerting its influence upon the mixed or superinduced colouring matter employed in dyeing another, produces effects which, in most cases, can only be ascertained by observation and experiment. Trusting, therefore, but little to the deductions of theory, our attention must be principally directed to the effects of the chemical agents we employ.

373. Pure or unmixed colours are rarely found in nature; and, indeed, in the preceding part of this article, we have described processes for dyeing colours, many of which were, strictly speaking, of a compound nature. Thus, red is almost uniformly found intermingled with yellow, scarlet, and madder colours, being composed of these principles; and indigo, which appears to furnish the most perfect blue, is always debased by a certain admixture of yellow. We did not consider these deviations, however, from the simple colours which we have already discussed, as a sufficient reason for separating processes nearly connected with each other, and which scarcely admit of any systematic arrangement that is altogether free from objection. The compound colours are as unlimited as the combinations of simple colours, by means of which they are formed. We can only consider, however, the principal mixtures; and these may be comprehended under the following classes.

1st. A mixture of blue and yellow, which produces all the intermediate shades between the yellowish-green, and the dark green verging to black.

2d. A mixture of red and blue, which comprehends all the shades from a deep violet colour to a blue.

3d. A mixture of red and yellow, which embraces all the shades from a scarlet colour to that of musk and tobacco.

Class I. Processes for Dyeing Mixtures of Blue and Yellow, or Green.

374. Several plants are capable of affording green colours, but the dyes which they communicate are all of a fading nature. D'Ambourne, indeed, asserts, that he had a permanent green from the fermented juice of the berries of the berry-bearing alder, by preparing the cloth with tartar, nitrous solution of bismuth, and common salt, and adding to the fermented juice of the berries, when warmed, a little acetic of lead. The cloth acquired in this bath a middle shade, between parrot and grass green. Green is obtained by the dyers from an admixture of blue and yellow, either of these colours being first applied, and then the other. It is usual, however, to apply the blue dye first, and afterwards the yellow. The pastel vat is commonly employed; but for some kinds of green, the solution of indigo in the sulphuric acid is used. In the latter case, the blue and yellow are either dyed separately, or all the ingredients are mixed together to dye by a single operation. Sometimes greens are produced by employing solutions of copper with yellow substances.

1. Processes for Dyeing Wool Green.

375. The blue ground, which is usually applied first, ought to be proportioned in intensity to the deepness of the green we wish to obtain: Thus for the green like that of a drake's neck, a ground of deep royal blue is given; for parrot green, a ground of sky blue, &c. The cloths having received the proper ground, they are washed in the fulling-mill, and then boiled as for common welding; but for the lighter shades, a smaller quantity of salts is used. In general, the cloths which are to have the lighter shades are boiled first; and when these are taken out, tartar and alum are added; and this practice is pursued until we come to the cloths intended for the darker shades, more and more tartar and alum being successively added.

376. The process of welding is conducted in the same manner as formerly described for dyeing yellow, with this difference, that a larger quantity of weld is employed, unless for the light shades, where the proportion is rather diminished. Frequently, a succession of shades, from the deepest to the lightest, is dyed at the same time, beginning with the deepest, and proceeding to the lightest. Between each dip, which lasts from half an hour to three quarters, water is added to the bath. Some dyers give each parcel two dips, beginning the first with the deep shades, and the second with the light ones. In that case, each parcel should remain a shorter time in the bath, which should never be allowed to reach the boiling point for the lighter shades. Deep greens are browned with logwood, and a little sulphate of iron.

377. The green obtained by means of solutions of indigo in sulphuric acid, known by the name of Saxon green, is more beautiful than the green procured by the preceding process, but it has less durability. According to a description of the process published in 1750, by the French government, the cloth for this dye is boiled for half an hour with alum and tartar, and then taken out and aired, without being washed. The bath is next to be cooled, and the solution of indigo well mixed with it, adding at first only one-half; the cloth is then put in and turned rapidly, without boiling, for five or six minutes; it is then taken out, that the remainder of the
solution may be added, which ought to be mixed with great care. After having gently boiled the cloth in it for seven or eight minutes, it is taken out and cooled; the bath is emptied to about three-fourths, perhaps somewhat more or less, according to the shade of green to be produced; it is then filled with a decoction of fustic, and when this bath is very hot, the cloth which had been dyed blue, and cooled, is dipped into it, until it has acquired the proper shade.

378. The following process, which is more simple, is described by Berthollet. A boiling is first given as for welding; and the cloth, being afterwards washed, fustic in chips inclosed in a bag is put into the same bath, and boiled for an hour and a half; it is then taken out, and the bath cooled to a temperature which the hand can support. Nearly a pound and a quarter of the solution of indigo, for each piece of cloth of eighteen ells to be dyed, is then added; at first it is to be turned rapidly, and afterwards slowly; the cloth is to be taken out before the bath boils. It is proper to put in only two-thirds of the solution at first, to take out the cloth after two or three minutes, and then to add the last third; the colour is thus rendered more uniform. If it is observed, that the colour does not take well, a little calcined alum reduced to powder is added. The Saxony-apple-green is dyed in the bath in which has served for Saxony green, after one-third or one-half of it has been taken out, and after it has been cooled. The cloth is turned in it until it is near boiling.

379. Woollen stuffs, which have previously been dyed blue in the common indigo vat, may also receive any of the various shades of green, which are usually communicated in this way from weld, by boiling them in water with about one-eighth part of their weight of alum, and afterwards dyeing them, without with about the same proportion of quercitron bark, and a little chalk added towards the end of the process. A beautiful Saxony green may be obtained from quercitron, by the following process, recommended by Dr Bancroft. The cloth having previously received the Saxony blue, should afterwards be well rinsed, to separate, as far as water will do it, the acid imbibed in combination with the indigo, and which has a strong tendency to throw down and weaken the quercitron, as well as the weld yellows. To counteract more effectually the operation of the acid, it will be proper to add about three pounds of chalk, with ten or twelve pounds of alum, for the preparation of a hundred pounds weight of cloth, which is to be turned and boiled, as usual, for about an hour; and then, without changing the liquor, ten or twelve pounds of bark, powdered and tied up in a bag, may be put into it, and the dyeing continued, taking care frequently to agitate the bag, in order that the colour of the bark may spread equally through the liquor. It will be found, however, that the yellow will manifest itself but slowly in this way, by reason of the sulphuric acid imbibed with the blue colour, joined to that of the alum in the preparation liquor, which the portion of chalk before mentioned will not have been sufficient to overcome; and therefore when the dyeing with bark has continued about 15 minutes, it will be proper to add another pound of clean powdered chalk, stirring it well through the liquor, and to repeat this addition afterwards, once, twice, and even three times, at intervals of six or eight minutes, if the colour does not rise sufficiently without it. By these additions, says Dr Bancroft, the quercitron yellow will manifest and apply itself abundantly and equally, so as to produce very beautifully greens, which, by varying the proportions of indigo, as well as of bark and alum, may be varied at pleasure. The chalk in this case does not merely answer the purpose of separating the acid left in the cloth, by the sulphate of indigo and the alum; but by uniting with this acid, it becomes a sulphate of lime, and fixes itself, in part at least, as a basis in the fibres of the cloth, where it helps to raise the colour, and also to render it a little more durable. At present the Saxony greens are commonly dyed with the old fustic, because the colour of this wood is not thrown down by acids, so much as that of the bark and weld, and this difference enables the dyer, when he has extracted the fustic colour by previous boiling, to mix the sulphate of indigo with it, and dye the cloth green by one operation, after it has been prepared as usual with alum and tartar. The process, however, which Dr Bancroft has described for doing this with bark, is fully as cheap and expedient, and the green produced will be more beautiful, because the quercitron yellow is more bright and clear than that of fustic, See Phil. Trans. Col. 135.

380. Dr Bancroft has described another process, by which beautiful Saxony greens may be produced, cheaply and expeditiously, by combining the yellow of quercitron, the murio-sulphate of tin and alum, with the sulphate of indigo. "To produce this combination most advantageously, (says he,) the dyer, for a full bodied green, should put into the dyeing vessel after the rate of six or eight pounds of powdered bark, (in a bag) for every hundred pounds weight of cloth, with only a small proportion of water, as soon as it begins to grow warm; and when it begins to boil, he should add about six pounds of murio-sulphate of tin, (with the usual precautions,) and a few minutes after about four pounds of alum; these having boiled together five or six minutes, cold water should be added, and the fire diminished so as to bring the heat of the liquor nearly down to what the hand is able to bear; and immediately after this, as much sulphate of indigo is to be added as will suffice to produce the shade of green intended to be dyed, taking care to mix it thoroughly with the dyeing liquor by stirring, &c; and this being done, the cloth, previously scoured and moistened, should be expeditiously put into the liquor, and turned very briskly through it for a quarter of an hour, in order that the colour may apply itself equally to every part, which it will certainly do in this way with proper care. By these means, very full, even, and beautiful greens, may generally be dyed in half an hour; and during this space, it is best to keep the liquor at rather less than a boiling heat. Murio-sulphate of tin is infinitely preferable, for this use, to the dyers' spirit; because the latter consists chiefly of nitric acid, which, by its highly injurious action upon indigo, would render that part of the green colour very fugitive, as I have found by repeated trials. But no such effect can result from the murio-sulphate of tin, since the muriatic acid has no action upon indigo, and the sulphuric is that acid which alone is proper to dissolve it for this use. Respecting the beauty of the colour thus produced, those who are acquainted with the unequalled lustre and brightness of the quercitron yellows dyed with the tin basis, must necessarily conclude, that the greens composed therewith, will prove infinitely superior to any which can result from the dull muddy yellow of old fustic: and in point of expense, it is certain that the bark, murio-sulphate of tin, and alum, necessary

Advantages of this process.

Another process still more advantageous.
to dye a given quantity of cloth in this way, will cost less than the much greater quantity (six or eight times more) of fustic, with the alum necessary for dyeing it in the common way; the sulphate of indigo being the same in both cases. But in dyeing with the bark, the vessel is only to be filled and heated once; and the cloth, without any previous preparation, may be completely dyed in half an hour; whilst, in the common way of producing Saxon greens, the copper is to be twice filled; and to this must be joined the fuel and labour of an hour and a half's boiling and turning the cloth in the course of preparation, besides nearly as much boiling in another vessel, to extract the colour of the fustic; and, after all, the dyeing process remains to be performed, which will be equal in time and trouble to the whole of the process for producing a Saxon green with the bark; so that this colour obtained from bark will not only prove superior in beauty, but in cheapness, to that dyed as usual with old fustic." See Phil. of Perm. Col. vol. ii. p. 136.


381. When silk is to be dyed green, the process of scouring is the same as for other colours; but when the lighter shades are to be applied, that operation must be performed as effectually as for blue. The dyeing process is managed a little differently from that of woollen stuffs. The silk, after being well alumed, is slightly washed at the river, and divided into small hanks, that it may receive the dye as equally as possible, it being extremely difficult to prevent the green being spotted or striped. It is then put into the weld bath, and carefully turned. After the ground is thought sufficient deep, a pattern is tried in the vat, to ascertain if the colour has acquired the proper shade; if not, decoction of weld is added until this is the case. The silk is then taken out of the bath, washed, and dipped in the vat as for blue. To deepen and vary the hue, decoction of logwood, fustic, or annotta, are sometimes added to the yellow bath, after the weld has been taken out or exhausted; and for the very light shades, such as apple and sea-green, a much weaker ground is given. Yellow baths, which have been already used, answer best for the delicate shades, as the silk takes the colour from these more slowly and uniformly.

382. When the blue vat is employed to dye green, saw-wort (159) may be substituted for weld; it is even preferable, because its yellow is naturally of a greenish cast; dyers' brown may also be used, and sometimes these substances are mixed together. Other substances, affording a yellow colouring matter, may be employed for the same purpose, and particularly quercitron, which affords so many beautiful shades of yellow.

383. Saxon green may be communicated to silk, according to Guldiche, by three yellow substances, turmeric, fustic, and French berries; and to these may be added quercitron. The greens obtained by means of turmeric are the most beautiful and delicate, but they are also the most fading. The silk is alumed in the proportion of four ounces of alum to the pound; and left twelve hours in the solution when cold. A bath is prepared with an ounce of pounded turmeric, to which as much sulphate of indigo as will give it a sufficiently green colour is added; an ounce of solution of tin is then mixed with it, and the alumed silk dipped until it has acquired a fine green colour. It is then wrung, washed, and dried in the shade. When fustic is used, the yellowing is conducted in the same manner as with weld. If the tincture of French berries in aceto-citric acid be employed, half the quantity of alum may be taken that has been recommended for turmeric; in other respects, the process is the same.

384. Dr Bancroft gives the following simple process for producing, with quercitron, Saxon greens by one operation. Boil, after the rate of four pounds of quercitron bark with three pounds of alum, and two pounds of muriro-sulphate of tin, in a suitable quantity of water, for ten or fifteen minutes; when the heat of the liquor is afterwards reduced, so that the hand can bear it, put in the silk, and retain it a proper time in the bath, taking care, however, to agitate the liquor constantly, that the colouring matter, which would otherwise subside, may be kept equally diffused. By adding suitable proportions of sulphate of indigo to this yellow liquor, and keeping it well stirred, various and beautiful shades of Saxon green may be dyed in the same way, of a uniform shade, and at a small expense. The shades intended to incline most to the yellow should be first dyed, and afterwards, by adding more sulphate of indigo, those partaking more of the blue may be readily produced; and, indeed, says Dr Bancroft, nothing can be more commodious or certain, than this way of dyeing the most beautiful Saxon greens upon silk. See Phil. of Perm. Col. vol. ii. p. 147.

385. A dye called English green, which unites the beauty of Saxon with the durability of common green, is sometimes applied to silks. In order to give this green, Guldiche first gives the silk a light blue in the cold vat, soaks it in warm water, and washes it in a stream; he then dips it in a weak solution of alum, prepares a bath with the sulphate of indigo, an ounce of solution of tin, and the tincture of French berries. In this bath the silk is kept till it has taken the desired shade of green, when it is washed and dried in a shady place. The shades are rendered more or less blue or yellow, by the proportions of the ingredients by which these colours are communicated. When a goaling green is to be given to silk, it is first dyed of a light blue, green, then passed through hot water, and washed in a stream; lastly, while still moist, it is dipped in an annotta bath.

111. Processes for Dyeing Cotton and Linen, Green.

386. When cotton or linen is to be dyed green, a ground of ground of blue is commonly applied first, the stuffs being previously been properly secured. The proportion of yellow is regulated by the shade of colour to be given; and so also is the previous ground of blue. Pileur de Aplegny has described a process for dyeing cotton, or skeins of cotton, of a sea or apple green, Sea or apple green, in a single bath. For this process, verdigris is mixed green with vinegar, and the mixture kept well stopped fifteen days in a stone; four hours before using it, a solution of potash, equal in weight to that of the verdigris, is added, and the mixture is kept hot. The cotton thread or velvet are prepared, by being soaked in a warm solution of alum, made in the proportion of one ounce of salt, and five quarts of water, to the pound; they are then taken out, and the verdigris mixture added to the bath, into which they are returned, in order to be dyed.

387. To dye beautiful greens upon cotton, Chapital Chapital's has recommended that it be first dyed of a sky-blue process colour, by means of indigo dissolved by potash and orpinment, and afterwards macerated in a strong decoction of sumach; it is then to be dried and soaked in
the acetate of alumine; dried again, rinsed, and finally dyed with quercitron bark, employing twelve pounds of the latter to fifty pounds of cotton.

387. The various shades of olive green, and drake's neck green, are given to thread after it has received a blue ground, by galling it, and dipping it in a weaker or stronger bath of the acetate of iron, then in the weld bath with verdigrise; and lastly, in the bath with sulphate of copper. After the dyeing process is finished, the colour is brightened with soap.

388. In describing the processes of dyeing by means of Prussian blue, we described a method of applying that colouring matter to cloth, which had been suggested by Dr Bancroft: he also ascertained that if, instead of dyeing the cloth with weal or quercitron bark, and sulphate of iron only, he used alum along with the latter, an olive was produced; and this being soaked, as before mentioned, in warm diluted prussiate of potash (neutralized with sulphuric acid), it produced a beautiful green; the alum and quercitron bark or weal furnishing a sufficient quantity of yellow for that purpose, and the Prussian blue, by its superior brightness, giving the green an increased lustre. It is unnecessary to mention, that this green would be instantly tarnished, and at last decomposed entirely by soap.

CLASS II. Processes for Dyeing Mixtures of Red and Blue.

390. By various mixtures of red and blue, we obtain violet, purple, dove-colour, pansy, amaranth, lilac, and a great number of other shades, determined by the nature and proportion of the colouring matters used in the production of the simple colours, and the mordants employed to give them fixity, or heighten their lustre.

1. Processes for Dyeing Wool, Violet, Purple, &c.

391. According to the observations of Hellot, stuffs which have previously received the scarlet dye, take an unequal colour when blue is superadded. The blue is, therefore, given first, which even for violet and purple ought not to be deeper than the shade distinguished by the name of sky-blue. After a boiling has been given with alum, mixed with two-fifths of tartar, the stuff is dipped in a bath, composed of nearly two-thirds as much cochineal as for scarlet, to which tartar is always added. The only circumstance in which the process for dyeing purple differs from that for dyeing violet, is, that for the former a lighter blue ground is given, and a larger proportion of cochineal. Lilacs, and other light shades of the same kind, may be produced, by employing these means more sparingly, or by using the baths which have already been employed for dyeing full violets and purple. A little solution of tin is added, for some reddish shades, such as peach-blossom.

392. Perrner has recommended the sulphate of indigo, instead of the indigo vat, as producing a brighter blue, for the basis of purple and violet, and that too by a shorter and less expensive process. The colours obtained in this way are, indeed, not so durable as when the blue vat is employed; but Perrner asserts that their durability may be increased by the addition of alkali to the solution of indigo. He accordingly prepares a pound of cloth, with three ounces of alum, by boiling it for an hour, and half, and leaving it for a night in the liquor after it is cold. He makes the bath with an ounce and a half of cochineal, and two ounces of tartar, boiling it for three quarters of an hour, and then adding two ounces of solution of indigo, he stirs, and makes it boil gently for a quarter of an hour. He thus obtains a very beautiful violet. Other shades, resulting from the mixture of red and blue, are obtained, by increasing or diminishing the proportion of solution of indigo. He increases it as far as five ounces, and diminishes it to five draughts for each pound of cloth; he also reduces the quantity of cochineal, but never below an ounce, as the colour would then become too dull; he changes the proportion of tartar; and, lastly, he varies the preparation given to the cloth, by the addition of tartar, or solution of tin in different proportions.

393. With respect to these processes, it is justly remarked by Dr Bancroft, that the cochineal colour will only be united to the aluminous, and not to the tin basis; and, consequently, that they can only produce a crimson, of much less vivacity than the rose colour, which it would afford with a nitro-murrain of tin. But this latter mordant has always been avoided in dyeing purple and violet with indigo, on account, of the injurious effects which it produces on the colouring matter of that substance. The same objection does not apply to the muri-sulphate of tin, as the muriatic acid has no effect upon indigo, nor even the sulphuric in the very diluted state in which it is used in that mordant. Dr Bancroft has, therefore, very happily introduced the use of the muri-sulphate of tin with cochineal and the sulphate of indigo, for dyeing the colours in question, and produced violets and purples of greater beauty and vivacity, than can be obtained by the preceding processes. See Phil. of Permac. Col. vol. ii. p. 383.

394. Logwood is sometimes employed to communicate to wool, sloe, damascene, purple, and other shades, which may be considered as modifications of red and blue. This wood, with the addition of galls, readily affords all these colours to wool; but they possess little stability. Decoruzille, a well-informed dyer in France, has, however, disclosed a process to Berthollet, by which he succeeded in obtaining, from logwood, a very good and durable dye. The mordant he first employed was composed of solution of tin, muriate of soda, (common salt,) acullus tartarite of potash, (cream of tartar,) and sulphate of copper. He afterwards learned a better way of preparing it from M. Gros, who formed it by dissolving the tin in a mixture of sulphuric acid and sea salt, with a suitable portion of water, to which the tartarite of potash and sulphate of copper were added afterwards. Wool, in the fleece, was dyed with this mordant, by employing the latter in the proportion of one-third of the weight of the stuff; but for cloth, one fifth was deemed sufficient. A bath was prepared of a temperature which the hand could bear, with which the mordant was well mixed. The wool was then dipped in it and duly stirred, the same degree of heat being kept up for two hours, and even increased a little. The cloth was then taken out, aired, and well washed. A fresh bath of pure water was then prepared, to which a sufficient quantity of the decoction of logwood was added. The stuff was again immersed, stirred, and the bath raised to a boiling heat, which was continued for a quarter of an hour. The stuff was then taken out, carefully rinsed, and dried, which finished the process. When a portion of Brazil wood was added, the shade partook more of the red, and afforded the colour known in France by the name of prune de Monsieur.
II. Processes for Dyeing Silk, Violet, Purple, &c.

395. In dyeing silk, two kinds of violets are distinguished, the fine and the false. To produce the fine violet, the silk is first passed through a bath of cochineal, and afterwards dipped into the indigo vat. More or less cochineal is used, according to the depth of the desired shade; but neither tartar nor solution of tin form parts of the mordant, which consists of alum only. The usual proportion of cochineal for a fine violet is two ounces for each pound of silk. When the silk is dyed, it is washed at the river, and beaten twice. It is then dipped in an indigo vat, of greater or less strength, according to the depth we wish to give the violet. It is then washed, and carefully dried. To give greater beauty and strength to the colour, it is commonly passed through the archil bath; a practice which, as Berthollet observes, though frequently abused, is indispensable for the light shades, the colour of which would otherwise be too dull.

396. When the silk is intended to be dyed purple, a very light blue shade must be given to it, after receiving the cochineal dye. The deepest shades must be dipped in a very weak vat, and those which are lighter, in cold water, with which a little of the liquor of the vat has been mixed. The light shades of this colour, such as gillyflower, gridelin, peach-blossom, &c. are obtained by reducing the proportion of cochineal.

397. The false violets are given to silk in various ways, but the most beautiful are usually communicated by archil, the strength of the bath being adapted to the colour we wish to produce. After being scoured and beaten at the river, the silk is introduced into the bath, and turned in it on skin sticks. When the colour is supposed to have sufficiently taken, a pattern is tried in the indigo vat, to ascertain if it acquires the desired shade of violet; and after the shade is found to be of the proper depth, the silk is beaten at the river, and dipped in the vat, in the same manner as for the fine violets.

398. A violet is given to silk, by dipping it in water containing a solution of verdigris, without alumming it, and then giving it a bath of logwood. The blue colour which it assumes in the bath is changed to violet, either by the addition of alum while it remains there, or by passing it, after being taken out, through a weaker or stronger solution of that substance. This violet possesses neither durability nor beauty. A better violet may be communicated, by passing alummed silk first through a bath of Brazil wood, and again, after it has been washed at the river, through a bath of archil.

III. Processes for Dyeing Cotton or Linen, Violet, Purple, &c.

399. Cotton is usually dyed violet, by first giving it a blue ground in the vat, suited to the proposed deepness of shade, and then drying it. After being left for twelve or fifteen hours in a gall bath, prepared in the proportion of three ounces of galls to a pound of the stuff, it is again wrung and dried. It is next passed through a decoction of logwood, from which, after being well soaked, it is taken out, when two drachms of alum and one drachm of dissolved verdigris for every pound of cotton, are added to the bath. It is then redipped on the skin sticks, and turned for a full quarter of an hour, after which it is taken out and aired. This being done, it is once more immersed in the bath for a quarter of an hour, and then taken out and wrung. The dyeing is completed by introducing the cotton into a fresh bath of logwood, to which two drachms of alum are added, and retaining till it acquires the desired shade.

400. Violets and purples, extremely durable, may be communicated to cotton prepared and dyed as for the Turkey red, with this difference, that to the alum-steep or mordant, a greater or less portion of sulphate of iron is added, according as the colour is wished to incline more or less to a dark shade. Cotton which has received a light indigo blue, may also be rendered purple or violet, by impregnating it with the aluminous basis, and dyeing it with madder.

401. A good and durable violet, may also be applied to cotton or thread by the following process: The cotton to be dyed is macerated in a decoction of galls, (employing one pound of the latter to six pounds of the former,) then dried, and afterwards soaked in a saturated solution of equal parts of alum and sulphate of iron; it is then rinsed, dried, and afterwards dyed with its weight of madder. The colour, which is durable, may be made to incline more or less to the purple or violet, by varying the proportions of alum and sulphate of iron. An acetate or pyroglignite of iron may be advantageously substituted for the sulphate.

Class III. Processes for Dyeing Mixtures of Red and Yellow.

402. An infinite variety of shades may be obtained from the combination of red and yellow, by altering the proportions of the ingredients which afford these colours, and varying the mordants employed in the dye bath. Pernier also describes a great number of varieties of the same kind, which he produced by using different yellow dyes, and by employing in the preparation of the stuff in the bath, tartar, alum, sulphate of zinc, or sulphate of copper. The principal colour resulting from this combination is orange.

II. Processes for Dyeing Wool, Orange, &c.

403. By boiling fustic in a scarlet bath, and heightening it by a small portion of cream of tartar and the solution of tin, we may produce successively a pomegranate, orange, a jonquille, &c. Quercitron may be substituted for fustic, and both must be used in proportion to the shade required. The addition of a little madder will produce a gold colour. If, in place of bright yellows, we employ colouring matters of a brownish cast, such as the greater number of astringents, we shall obtain less brilliant but more solid colours: thus hazel roots, walnut peels, sumach, &c. yield tobacco, chestnut, musk colours, &c.

II. Processes for Dyeing Silk, Orange, &c.

404. In describing the processes for dyeing silk yellow, we noticed various methods of giving it an orange cast. Marrones, cinnamon, and all the intermediate shades, are communicnted to silk by various proportions of logwood, Brazil wood, and fustic. The silk having been scoured as usual, and alummed, is put into a bath prepared by mixing decoctions of these woods, according to the desired shade, but causing the fustic to predominate. The silk is turned in the bath in the usual way, and afterwards introduced into a fresh bath of the same.
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Ingredients, if necessary. Brick colours are given by dipping the silk, prepared with solution of galls, mixed with a certain quantity of solution of iron, in an annato bath.

III. Processes for Dyeing Cotton or Linen, Orange, &c.

405. For the different shades of marrone, cotton is galled, and then dipped, and worked in the usual manner, in a bath to which more or less of the pyrolytine of iron has been added; it is then washed in a bath, with which verdigrise has been mixed, welded, and dyed in a bath of fustic, to which a solution of soda and alum are sometimes added. After the cotton thus prepared has been completely washed, it is well muddled, then dipped in a weak solution of sulphate of copper, and, lastly, in soap-suds.

Cinnamon and mor-dore colours.

406. Cinnamon and mor-dore colours are given by dyeing them first with verdigrise and weld; they are then dipped in a solution of sulphate or acetate of iron, wrung, and dried. When dry, they are galled, in the proportion of three ounces of galls to the pound of stuff, dried again, alumed as for red, and muddled. When dyed and washed, they are put into very warm soap-suds, and turned until they are sufficiently bright. Decoration of fustic is sometimes added in the aluming.

407. According to M. le Piaire d'Apligny, a fine olive may be communicated to thread and cotton, by boiling separately four parts of weld with one of potash, in a sufficient quantity of water, and Brazil-wood which has steeped over night with a little verdigris, and then mixing the two solutions in different proportions, according to the shade required, as a dyeing bath. The cotton and thread are then dipped in it, in the usual way.

CHAP. V.

Processes for Dyeing Black.

408. The appearance called black, consisting strictly in the absence of all colour, the processes for producing it upon stuffs could not with propriety be introduced either under simple or compound colours; it ought to be remarked, however, that the dyer is but little influenced by the prismatic distinctions, and regards as a colour every palatable change produced on the appearance of stuffs by the union of vegetable matter. Black is therefore usually treated, by the writers on dyeing, as a simple colour; but with no great propriety, for though this appearance may certainly be communicated to stuffs by means of a mordant, and a single vegetable colouring matter, the most beautiful and perfect blacks are given by a combination of several colours. These considerations have induced us to allot to it a separate Chapter, and to give the processes for dyeing black, after having described the methods of applying colours, properly so called. At the same time, that we may not increase to an unnecessary degree the subdivisions of this article, founded upon distinctions of colour, we shall annex the methods of dyeing such shades of colour as may be considered to be modifications of black with other colours.

409. Perhaps no substance in nature possesses the property of absorbing all the rays of light; and, accordingly, there can scarcely be said to be any colouring matter which is capable of dyeing, alone, a deep and permanent black. The juice of the cashew-nut communicates to linen a dark colour, but it cannot be called black. The same may be said of the anacardium occidentale, and several other plants, which produce similar effects. And, indeed, as Dr. Bancroft justly remarks, a substance which was perfectly black, and neither reflected nor transmitted a single ray of light, would be absolutely invisible, and incapable of exciting any sensation of colour whatever. What we commonly denominate black, therefore, does not result from a total absorption of the rays of light, but from a feeble reflection or transmission of those which are dark-coloured. Black may, accordingly, be produced upon stuffs by a condensation of such matters as reflect the dark rays most imperfectly, particularly blue and violet.

410. Several substances, both animal and vegetable, possess the property of forming very dark compounds with the oxide of iron, at a maximum of oxidation; this is the case with the prussic acid, and more especially with what is called the astringent principle. Blacks are, therefore, usually communicated to stuffs by means of the salts of iron, and the astringent principle. A ground of blue is generally given, before the application of the black dye, as then a less quantity of the ingredients is necessary to produce a deep tint, and the stuff is less apt to be injured by the ferruginous mordant. A ground of any other dark colour may be used instead of blue, but the black will be inferior in deepness and glossiness.

I. Processes for Dyeing Wool, Black, &c.

411. According to the process described by Heliot, Heliot's woolen cloth, which is to be dyed black, ought previously to receive a deep blue ground, to be washed in the river immediately after being taken out of the vat, and afterwards cleansed at the fulling-mill. For a hundred pounds of stuff, ten pounds of logwood, and an equal quantity of Allepo galls in powder, are put into a bag, and boiled for twelve hours in a copper, with sufficient quantity of water. One-third of this bath is transferred to another copper, with two pounds of verdigris, and into this the stuff is immersed, turning it continually for two hours, and keeping the bath very hot, without allowing it to boil. The stuff is then taken out, and a portion of the bath, equal to the former, is put into the copper, with eight pounds of sulphate of iron. While the sulphate of iron is dissolving, the fire is diminished, and the bath suffered to cool for half an hour; the stuff is again put in, moved well about for an hour, and again taken out to air. The remainder of the bath is now added, taking care to press the bag well, which contains the dyeing ingredients. Fifteen or twenty pounds of sunchine are also added; and the bath being brought just to the boiling point, the ebullition is instantly checked with a little cold water. Two pounds more of sulphate of iron are added, and the stuff is immersed for another hour. It is then taken out, washed, aired, and returned again to the copper for another hour, during which it is constantly stirred. Lastly, it is taken out, well washed at the river, and fulled. When the water comes off clear, another bath is prepared with weld, which is made to boil for a moment, and, after being cooled, the stuff is passed through it, to soften it, and give the black a better body.

412. Heliot describes another process, which is less tedious and complicated than the preceding, but it produces an inferior black. He recommends for fifteen ells of deep blue cloth, a bath composed of a pound and a
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half of yellow-wood (morus tinctoria), five pounds of logwood, and ten pounds of sumac. After boiling the cloth in this bath for three hours, it is taken out, when ten pounds of sulphate of iron are put into the copper, and the cloth is kept in it two hours longer: it is then aired, put into the bath again for another hour, and, lastly, washed and fulled.

418. Broad cloth may be made to acquire a black, in every respect unexceptionable, by boiling it two hours in a decoction previously prepared with about one-seventh of its weight of galls, and as much chiplog wood; afterwards passing it for another two hours through a solution of one-tenth of its weight of sulphate of iron, and keeping the solution at a scalding heat only. Most dyers are satisfied with a smaller proportion of galls, and supply the deficiency by increasing the quantity of logwood, and by adding also a portion of sumac.

414. For coarse stuffs, and cheap woollens, the blue ground from wood is omitted, its place being badly supplied by logwood and sulphate of copper or verdigrise; or the latter is dissolved with the sulphate of iron to convert a part of the colouring matter of the logwood into a kind of blue. Dr. Bancroft disapproves of this practice. He says, that the only use of the sulphate of copper, or verdigrise, is, to produce a logwood blue, which soon changes to a rusty brownish colour; and that it would be better to use the logwood with the sulphate of iron alone: (Phil. of Perm. Col. ii. 454.) He adds, that, with sulphate of iron and logwood, it is not difficult to produce a full and deep black, but that it is not so lasting as the black with sulphate of iron, and galls or sumac, either alone, or with a moderate proportion of logwood; which last certainly improves the appearance of the black dyed from galls and iron, by rendering it more intense, glossy, and soft. All black cloths, for the dyeing of which a large proportion of logwood has been used, are reddened by the application of muriatic acid; a little liquid ammonia restores the colour.

415. About the year 1733, Bergman strongly recommended a method of dyeing cloth black, by dipping woollens which had previously received a blue ground, in a bath composed of eight pounds of cream of tartar, sixteen pounds of sulphate of iron, two pounds of verdigrise, and ten pounds of wood, to a hundred pounds weight of cloth, and afterwards boiling it for two hours in a decoction of a hundred and fifty pounds of urush, or bear’s foot.

416. Dr. Bancroft states, that a fine lasting black may be dyed, without iron or any other basis, upon blue cloth, from a species of lichen, musca pulmonaria, (91.) and that, if this substance could be readily and copiously obtained, it would, probably, deserve to be preferred to madder and woad for rendering blue cloth black.

417. The proportions of ingredients for dyeing black, usually employed by the dyers of this country, are, for a hundred pounds of woollen cloth, dyed first a deep blue, about five pounds of sulphate of iron, the same quantity of galls, and thirty pounds of logwood. The cloth is first galled, and then passed through the decoction of logwood, to the sulphate of iron has been added. When the cloth is completely dyed, it is washed in a river, and full’d till the water comes off clear and colourless. Some recommend fine cloths to be full’d with soap-suds; but this operation requires an experienced workman to free the cloth perfectly from the soap. Many advise to give the cloth a dip in a bath of weld when it comes from the fulling-mill, which is said to soften, and fix the black.

418. To give a browning, the stuff which has been just dyed, is dipped in a solution of sulphate of iron, to which an astringent has been added. More frequently a small portion of solution of iron is mixed with a bath of water; and more is added, till the stuff dipped in it has attained the desired shade. Permnr frequently soaks the stuff in a solution of sulphate of iron; to which he sometimes adds other ingredients; and, when taken out of this mordant, he dips it in the dye bath. The first method is employed for marrones, coffee, damascene colours, and other shades of browns; a more or less deep colour being given them, according to the shade we wish to obtain by browning: a bath is then prepared of galls, sumac, and elder bark, with the addition of sulphate of iron. The stuffs intended for the lighter shades are dipped first; and, when they are finished, the browner ones are dipped; a quantity of sulphate of iron, proportionate to the end proposed, being added for each operation.

419. Dye colours, of various shades, are very conveniently and cheaply dyed, by the queretron-bark, and an iron basis. For this purpose, Dr. Bancroft recommends the bark to be boiled for a few minutes in a copper vessel, with one-third or one-fourth of its weight of sulphate of iron; and the liquor having been well mixed, and a little cooled, the cloth may be dyed in it as usual. To sadden and darken the colour still further, a little sumac may be employed with the bark. See Phil. of Perm. Col. ii. 144.

II. Processes for Dyeing Silk, Black, &c.

420. Silk which is intended to be dyed, is commonly galled by boiling four or five hours with a fifth of its weight of white soap, after which it is beetled and carefully washed. It is then galled, by leaving it from twelve to thirty-six hours in a decoction prepared with about three-fourths of its weight of galls, which have been boiled three or four hours; after which it is taken out, and washed in the river.

421. As silks are capable of combining with a greater or less quantity of the astringent principle, they receive, when dyed black, a greater or a less augmentation to their weight, not only from the astringent principle, but also from the oxide of iron which combines with it in like proportion. The dyeing process is, therefore, varied, according as the operator is desirous of rendering the silk more or less heavy. Hence the distinction of light and heavy blacks.

422. The difference in the process for obtaining heavy black, consists in leaving the silk a longer time in the decoction of galls, in repeating the galling, in dipping the silk in the dye a greater number of times, and leaving it longer in the bath each time.

423. Silk dyers usually preserve a vat for the black, Vat for and its composition, which generally consists of many superfluous ingredients, and varies greatly in different dye houses. The vat is frequently continued for many years, the black dye being always renewed when it is nearly exhausted. Macquier has given a description of one of these vats; it contained seeds of fenugreek, fen-wort, cimmin, colocynth, buckthorn berries, agric, nitre, ammoniac, sal gem, litharge, antimony, lead ore, opiment, corrosive muriate of mercury, together with a variety of other ingredients apparently added at random. Mac
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It acknowledges, that many of these substances are useless; and, indeed, few of them are now employed. Iron filings are generally added to the dye-bath; but some dyers in France use in its stead the powder found in the trowths of cutlers' grindstones.

Dyeing process.

425. The bath for dyeing silk ought never to be allowed to boil. Gum and solution of iron are added to it; in different proportions, according to the various processes; and when it is observed that the gum is dissolved, and the liquor nearly boiling, it is allowed to settle for about an hour. The silk, being dipped in the bath, and managed in the usual way, is taken out when it has absorbed a sufficient quantity of the dye, wrung, and exposed to the action of the air, which deepens the black. After it has had three wringings, the bath is heated anew, fresh portions of gum and sulphate of iron being added as at first: the operation performed in the interval between two heatings is, in France, called a fire (un feu). The light black receives two fires, but the heavy requires three; and the silk is also allowed to remain in the bath for twelve hours after the last fire. When the dyeing is finished, the silk is rinsed in a vessel with cold water, by turning or shaking it.

426. The quantity of galls necessary for dyeing silk black, renders the process very expensive; and it is therefore an object of considerable importance, to find some method of diminishing their quantity. The following process has, for this purpose, been recommended by M. Anglès, who was a competitor for the prize proposed in 1776, by the Academy of Lyons, of which he was the object.

M. Anglès' process.

427. Silk carefully boiled and washed in the river, is to be immersed in a strong decoction of green walnut peels, and left in it till the colour of the bath is exhausted. It is then taken out, slightly wrung with the pin, dried, and washed in the river. The decoction of walnut peels is made by boiling a full quarter of an hour, when it is taken from the fire, and allowed to subside before dipping the silk, which has been previously immersed in warm water. A blue ground is next given, by means of logwood and verdigris. For every pound of silk, an ounce of verdigris is dissolved in cold water; the silk is left in this solution two hours; it is then dipped in a strong decoction of logwood, wrung out slightly, and dried before it is washed at the river. For light blacks, gelling may be altogether omitted; but to obtain a heavy black, half a pound of galls may be used for every pound of silk. To prepare the bath, two pounds of galls and three of sumach, are macerated in twenty-five gallons of water, over a slow fire, for twelve hours. After straining, three pounds of sulphate of iron, and as much gum-arabic, are dissolved in it. In this solution, the silk is dipped at two different times, leaving it in two hours each time, taking care to air it after the first dipping, and to dry it before giving it the second fire, when it is to be again aired and dried. It is then beetled twice at the river; after which a third fire is given it in the same manner as before, except that it is left in the bath four or five hours. When drained and dried, it is again beetled twice at the river. Care must be taken that the heat during the operation do not exceed 192° of Fahrenheit's thermometer; and before the last two fires, half a pound of sulphate of iron, and as much gum-arabic, must be added. For removing the harshness of the black, M. Anglès prefers the decoction of weld to the solution of soap.

428. M. Anglès asserts, that if silk be dyed blue with indigo, previous to its being dipped for black, it will take only a mealy colour; but that a velvet black will be obtained if it be prepared with logwood and verdigris. He says also that green walnut peels soften the silk. Though a fine black may be procured from green walnut peels, and the bath above described, he notwithstanding adds logwood and verdigris, that he may not be obliged to use a large quantity of sulphate of iron, which weakens the silk. Lastly, he thinks that galls serve only to give the silk weight, and that sumach is sufficient for the dye.

429. The Chinese are said to improve their black dye upon silk, by passing it, when dyed, through a bath containing one pound of starch, with half as much of the oil of linseed, or of rape or hempsed, for every five or six quarts of water. A great variety of shades are obtained by the mixture of Brazil-wood, logwood, archil, and galls, and by a burning with sulphate of iron; but all these shades, though they have a pleasing lustre, are apt to fade. It is rather by the eye, than by any particular rules, that the dyer is to be guided in communicating them.

III. Processes for Dyeing Cotton and Linen, Black, &c.

430. In order to dye cotton and linen black, a solution of iron is employed, which, in France, receives the name of the black vat. The solution, which is a kind of acetate of iron, resembling a preparation of that metal, described under the head of Mordants (94.), is formed with vinegar or small beer, or small wine made from grapes, after they have been pressed, by adding water to them; rye meal, or some other ingredient being added, to assist the acetylation. Pieces of old iron are thrown into this liquor, which is allowed to stand till wanted, but never used in less than six weeks, or two months. To this bath astringents are frequently added, particularly the decoction of alder bark, which of itself has the property of dissolving a considerable portion of oxide of iron.

431. The following method of dyeing cotton and linen, as practised at Rouen, is given by M. le Pileur, a dyer at Rouen.

Process for dyeing.

The stuff to be dyed is boiled for twenty-five minutes, using four ounces of galls to every pound of stuff; and leaving it twenty-four hours in the gall liquor, after which it is again wrung out and dried. About five quarts of the liquor of the black vat are required for every pound; and a pound are then poured into a tub, in which the thread is worked with the hand, bound by pound, about a quarter of an hour, when it is wrung out, and aired. This operation is twice repeated, adding each time a fresh supply of the black vat, which ought to be carefully scummed. It is then taken out, aired, wrung, washed at the river to cleanse it effectually, and dried. When this stuff is to be dyed, a pound of alder bark for every pound of the stuff is boiled for an hour in a sufficient quantity of water. About half the bath that served for the galling; and half as much sumach as alder bark is then added, and the whole boiled together for two hours, and then strained through a sieve. When the liquor is cold, the stuff is put in and carefully worked, airing it from time to time: it is then let down into the
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342. The Abbé Mazèes has described a process for dyeing cotton and linen black, by dyeing them with madder, having previously prepared them with the souchou of the Turkey red, galling them with myrobalans, and passing them through a mordant, composed of lime-water and verdigrise. The process is tedious and expensive, and, according to M. le Pileur d'Apligny, does not produce a better black than is obtained by the preceding method.

343. M. le Pileur d'Apligny mentions another method of giving black to cotton and linen, which he describes as very fine and durable. The stuff is first scoured as usual, galled, alummed, and afterwards dipped in the cold bath. When taken out of this bath, it is to be dyed in a decoction of logwood, to which a quarter of a pound of sulphate of copper has been added for every pound of stuff. After this, it is to be washed in the river, and wrung repeatedly, but not too hard. Finally, it is dyed in a madder bath, in the proportion of half a pound to each pound of stuff. See Essai sur les Moyens, &c. p. 168.

344. Guthlichs has described a solution of iron, which produces excellent effects in dyeing black. He directs to boil a pound of rice in twelve or fifteen quarts of water, till it is wholly dissolved; into this solution is to be thrown as much old iron nailed red hot, as will come half way up to the surface of the liquor. This is to be done in a vat exposed under cover to the air and light, at least a week. An equal quantity of red hot iron is thrown into as much warm vinegar as there was solution of rice in another vessel, and in like manner exposed to the air and light. After some days the contents of the two vessels are to be mixed together, and the mixture is to be left a week exposed to the open air. The liquor is then to be decanted, and preserved in a close vessel for use. To dye cotton and linen in this mixture, all that is necessary is to leave them in the liquor till they acquire a sufficient black, which will not be longer than twenty-four hours at most. If the liquor do not contain enough of ferruginous particles, the stuff, after being taken out, must be put into fresh portion. In this way, a fine and permanent black will be produced.

345. In all the processes we have described, the gallick, when that operation was employed, was always given first, and the solution of iron applied afterwards.

Dr Bancroft considers this practice to be extremely injudicious, and proposes to reverse the order of these operations, applying first the solution of iron as a mordant, and then that of the galls as a colouring matter. "It is nutritious," says he, "that calico-printers, when they wish to produce any of the colous produced by the aid of iron, or its oxide, as a basis, invariably begin by applying the basis, (commonly the acetate or pyrolyzite of iron, separately to the calico, superimposing the vegetable colouring matter, and preserve them an ounce of vegetable colouring matter; excepting only in those cases where a less permanent permanent black or other colour is applied, for which the basis or mordant is previously mixed and combined with the vegetable colouring matters. And it is well known, that the black and other colours given by calico-printers from sumach, madder, weld, quercitron bark, &c. upon an iron basis, applied first and separately, are much more lasting than the same colours produced in a different manner by the ordinary dyers." He afterwards concludes, "and I am confident, from the results of many experiments, that being so applied, there can be no difficulty afterwards in producing a full and permanent black by dyeing the linen or cotton, which has received this basis, with a suitable portion of galls, with or without an addition of sumach, and even without the co-operation of a blue ground from indigo, which is commonly thought necessary, at least for the finer and more costly cotton or linen goods intended to be made black." (Phil. of Perm. Col. vol. ii. p. 469.) These observations certainly deserve the attention of the practical dyer.

346. For black-gray, iron-gray, and slate-gray, cotton Grayz, and linen have a blue ground given them, but for another. All the shades require a galling proportionate to the grey to be produced. When the thread has been gallicd, wrung, and dried, it is dipped on the skain sticks in a tub of cold water, to which is added a proper quantity of the bath from the black vat, and of a decoction of logwood: the thread is worked in this pound by pound, washed, and dried.

347. M. le Pileur d'Apligny gives the two following processes for gray:

1st, The thread is gallicd, dipped in a very weak bath of the black vat; and then maddered.

2d, The thread is dipped in a very hot solution of tartar, wrung gently, and dried. It is then dyed in a decoction of logwood. After this operation, the thread appears black; but on working it attentively in warm soop-suds, the surplus of the dye is discharged, and it remains olive, pleasing and durable.

For calico-printing, see Topical Dyeing.

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DYER, JOHN, an English poet of some note, was born in the year 1700, the second son of Robert Dyer of Aberglassney, in Caernarthenshire, an able and eminent solicitor. He was educated at Westminster school, under the care of Dr Freind, and was afterwards called home, to be instructed in his father's profession. But having little relish for legal pursuits, he, upon the death of his father, abandoned the study of the law; and, being fond of drawing, he became a pupil of the celebrated Richardson. After having studied for some time under this master, he wandered about South Wales, and the country adjacent, as an itinerant painter; and about the year 1727, he printed his first poetical production, Grongar Hill, in Lewis's Miscellany.

With the view of improving his talents as an artist, he undertook a journey to Italy; and upon his return to his native country in 1740, published the Ruins of Rome. Declining health, and love of study, afterwards induced him to enter into orders; and about the same time he married a lady of the name of Ensor, "whose grandmother," he says, "was a Shakespeare, descended from a brother of everybody's Shakespeare." He was fortunate enough to obtain several livings in the church, but did not long enjoy his ecclesiastical preferments. In 1757, he published his greatest poetical work, The Fleece; of which the following ludicrous anecdote has been transmitted. Dodsley, the bookseller, was one day mentioning it to a critical visitor with greater expectations of success than the other seemed disposed to admit. The author's age was asked; and being represented as advanced in life, He will, said the critic, be buried in woollen. He died in the year 1758.

Although neither the number nor the merit of Dyer's productions are sufficient to elevate him to the first rank among our English bards, yet he must ever be allowed a distinguished place in the list of our minor poets. Grongar Hill, according to the opinion of Dr Johnston, is the happiest of his effusions. But the well known antipathy of that celebrated critic to blank verse, seems to have rendered him blind to the merit of the other productions of Dyer; although he is forced to admit, that some passages are conceived with the mind of a poet. The title of the Ruins of Rome perhaps raises expectations which few poets are capable of gratifying; yet the poem of Dyer will be perused with a pleasure resulting at once from the sublimity of the subject, the grandeur of the conceptions, and the skilfulness of the versification. The Fleece, it must be admitted, is an unpromising subject for a poem, but Dyer has the merit of having given to it all the interest which the art of a poet could confer upon a barren topic. (2)
Dynamics.

Dynamics is that branch of Mechanical Philosophy which treats of the action of forces when they give rise to motion, and consists of the two following problems, viz.

1. From some of the circumstances which we observe in a motion, to determine the forces by which it is produced; and, 2. Conversely, from the knowledge which we have acquired of the forces, to determine all the circumstances of the motion to which they give rise.

It is customary, however, to give under Dynamics only the more general doctrines, and to reserve the rest for distinct articles. We shall, therefore, in this article, 1st, Give a short history of dynamics; 2dly, State some preliminary views with regard to the nature and measure of forces; 3dly, Lay down the general rules or laws according to which they act; 4thly, Deduce consequences with regard to their composition and resolution; and, 5thly, Apply these general doctrines to some of the most general cases of dynamics.

HISTORY.

The ancients were extremely little acquainted with dynamics. The wants of society, indeed, from the earliest times, required mechanical arts, and many of the Roman machines explained in Vitruvius excite our astonishment. But these inventions seem to have proceeded rather from numerous trials and natural sagacity, than from a proper acquaintance with the general principles of motion.

The ancients did not even know the first law of motion, and, instead of conceiving that the motion of a body was naturally uniform and rectilinear, they supposed that a circle, being the most perfect of figures, was that in which a body would naturally revolve. They cultivated both astronomy and geometry with considerable success; the former affording some of the finest examples of motion, and the latter furnishing the best assistance for the investigation of its properties; but they wanted our experimental method of inquiry.

Hence Aristotle, profound and accurate in most subjects, is extremely deficient when he treats of motion. Archimedes, it is true, who ranks at the head of ancient geometers as well as of ancient mechanicians, knew in some machines the true ratio of the power to the resistance in the case of equilibrium; but none of his writings discovers an acquaintance with the principle of the composition of forces, from which may be deduced the conditions of equilibrium in all machines, and still less does he appear to have been acquainted with the general method of calculating the motion of bodies, which forms the principal business of dynamics. In short, dynamics, as a science, is of modern date. The celebrated Galileo, about 200 years ago, laid the foundation of it. In his treatise on the motion of falling bodies, he showed that he was acquainted with the two first laws of motion, and likewise made a happy application of them. The law of reaction was a discovery of still later times. Des Cartes attempted to find out the law that obtains in the mutual collision of bodies, but failed, notwithstanding the acuteness of his genius. At last the Royal Society of London, after making it the subject of discussion at several of their meetings, devolved the task on three of their members, highly distinguished in that society, and throughout Europe, for their skill in geometry and mechanics. These were Wren, Wallis, and Huygens. The result was, that each separately made the happy discovery about the same time, in the year 1661. These three laws are the general principles on which hinges the whole of dynamical science, and indeed the whole science, whether of equilibrium or of motion.

Dynamics has continued to improve, by the happy examples that have been given of the application of these principles to the solution of particular problems: by deductions from these of other principles, less general, but more convenient for particular classes of questions; and likewise by every discovery in abstract mathematics, that great instrument for penetrating the secrets of nature. In all these respects, the contributions of Newton to dynamical science are beyond all praise. D'Alembert furnished a powerful principle, which will be given under Mechanics; and our countraman Mc Laurin, in his Fluxions, was the first to represent the motion of a body, by resolving the force that actuates it into directions parallel to fixed axis; a method that has contributed not a little to the solution of dynamical problems.

SECTION I.

Nature and Measure of Forces.

1. Force defined.—Any thing that causes, or tends to cause motion, is called force. The term is in familiar use; and the meaning attached to it by philosophers and the vulgar is the same. It is divided into two kinds, impulse and pressure. The former produces its whole effect almost instantaneously; the latter continues to act during a sensible portion of time. It comprehends pressures, properly so called, and also attractions and repulsions.

2. Measure of Weight.—We naturally judge two weights to be equal, when they produce exactly the same effect in the same circumstances; as when they counterpoise one another at the extremities of a balance, whose arms are precisely alike, or to whichever arm they are respectively suspended. We also naturally consider the parts of a body which are alike in every other respect as alike in point of weight, and thus conclude the weight of such a body to be proportional to its bulk. We actually find it to be so. Hence, by assuming the weight of a certain bulk of a certain body, a cubic foot of water for example, as an unit, and taking multiples and submultiples of that bulk, we obtain convenient measures of all weights whatsoever.

3. Measure of any other Pressure.—The pressure of gravity being thus easily measured, and also being one with which we are familiar, is well fitted to form a standard for measuring all other pressures. It is proper to bear in mind, that the specific gravity of a body is the weight of a certain bulk of it, and hence \( p = \frac{W}{RS} \).

4. Mass or Quantity of Matter measured.—Any thing is best measured by some quality which is measurable, which distinguishes it from every thing else, and which always belongs to it in the same degree, or whose variation, if there be any, is known. Weight possesses some of these properties, but in others it seems to be
DYNAMICS.

Nature and Measure of Forces.

But proof which pressure V a for not Bldi/ and different hence whether Impulse often effect the An will it has, compared...tion. — It is true, then, as it has often been said, that a force of impulse, however small, is infinitely greater than any force of pressure however great. The true state of the matter is this: An impulse produces, in a portion of time smaller than we can measure, a velocity as great as any force of pressure with which we are acquainted can produce in a considerable time.

Hence the one must be vastly greater than the other when the masses are the same; it follows, too, that we can in no case state the ratio; but it follows, at the same time, that the two forces may in some cases be equal, in consequence either of the mass moved by the force of pressure being exceedingly large, or that moved by the force of impulse being exceedingly small. Since, however, we are always acquainted with the time during which the action of impulse continues, we can in no case state the ratio of the two forces, and we can only in any case infer their equality from their balancing one another in like circumstances.

7. One Impulse compared with another.—Though we cannot compare an impulse with a pressure by the quantity of motion generated, yet we may by that principle compare impulses with one another; for the time in which each produces its effect being exceedingly small, and to us unknown, may be considered as the same; and hence the force may naturally be regarded as proportional to the momentum generated, or J = mv.

8. Force of a Body in Motion.—As we estimate a force by the quantity of motion which it communicates, so will we naturally estimate the force of a body in motion by the quantity of motion which it is capable of communicating by impulse before it is brought to rest.

Now, it will appear afterwards from the third law of motion, that a body communicates by collision just as much motion as it loses; hence it will be capable of communicating before it is brought to rest just all the motion it has, and hence its force will naturally be estimated by its momentum or quantity of motion, or J = mv. Some effects which a body is capable of producing before it is brought to rest, being proportional to mv, have made some philosophers consider the force as following that ratio. But the quantity of motion the body can communicate, seems to be the most natural measure which we can assume, as it preserves a harmony between this and other forces. The subject, however, is now generally allowed to be entirely a matter of definition; if the measure we mean to employ is explained before we set out, and strictly adhered to in the course of the investigation, it cannot alter the nature of our deductions; and the heat with which the controversy was long carried on betwixt the most eminent men, is a proof that sound metaphysics is not always found in conjunction with profound skill in mathematical and physical science. With regard to the force which a body in motion actually exerts in any given case of collision, it will be measured according to last article by the quantity of motion which it actually communicates to the other body. The method of predicting this will be given under Impulse. It will be there seen that it depends partly on the mass struck, but that when the two masses are the same, it is proportional to the velocity of the striking body.

SECTION II.

Laws of Motion, or General Rules according to which Forces act.

There are three general rules which a body obeys Laws of in its motion, whatever be the kind of body or the kind of force that impels it; whether it be a particle of dust driven by the wind, or a planet revolving in consequence of an original impulse through the celestial spaces.

These rules are the key that unlocks all the treasures
of mechanical philosophy: they form the guide, which, assisted by the torch of geometry, conducted the great Newton through all the labyrinths of nature.

Their simplicity, and the smallness of their number, give to mechanical science a generality and beauty which no other can boast.

Since they act so important a part through the whole of natural philosophy, it must be of the greatest consequence to establish their truth.

The first law describes what will happen to a body if left to itself, and unfolds a property of matter commonly known by the name of inertia. This law may therefore be called the Law of Inertia.

The second law describes what will happen when the body, impelled by any force, is at the same time acted on by several other forces, or has been previously put in motion, and therefore may be called the Law of Several Forces.

The third law maintains that when one body acts on another, the other reacts in a particular manner on the first, and may therefore be called the Law of Reaction.

**First Law, or Law of Inertia.**

A body does not change its state either of rest or of motion, unless in consequence of some external cause.

The most general principle in philosophical reasoning, indeed the foundation of all philosophy, is, that in the same circumstances the same event always happens; that, in like circumstances, a like event happens; and that the like the circumstances, the like is the event.

This principle is agreeable to the constitution of our minds, and confirmed by universal experience. In order, therefore, to shew, that in two given cases the effects shall be alike, we have only to shew that the circumstances, at least the influencing circumstances, are alike. Probably all the circumstances are never alike, and what are the influencing circumstances can only be known from previous experience on the subject in question. Again, in geometry, that property of a figure which we assume for its definition, involves all the other properties, so that they are deducible from it by a process of reasoning. This arises from the simplicity of the subject, and from the circumstance that all the other properties are of one kind. The case is different with an object existing in nature. We employ for its definition such a property, or assemblage of properties, as is sufficient to distinguish it from other objects. But the object may possess many properties which are independent of this, and cannot be deduced from it by reasoning. Having premised these remarks, we proceed to the proofs of the law.

Probably no body whatsoever is absolutely at rest, and every motion which we see commence, is perhaps only a change on some motion that previously existed. But every change evidently depends on mind, or on some other body. With regard to mind, it moves the body which it animates; but since it does not animate every body, it is not necessarily inherent in matter, and therefore its operation is to be considered as that of something external. With regard to other bodies, the direction of the change always depends on the direction of some other body, and the magnitude of the change on its distance; and hence we conclude, that if the action of mind and of other bodies were withheld, no change could ensue; that if the body were absolutely at rest, it would continue at rest; and if in motion, it would continue to move uniformly in a straight line. In short, we know from experience, that the circumstances on which its state of motion or rest depends, are not within itself, but wholly external. So long, then, as the external circumstances continue the same, so long, for instance, as there is no external action, its previous state of motion or rest must continue unaltered. This is a proof from reason.

We find accordingly, that, in proportion as we take care to diminish the effect of external action, the motion becomes more nearly rectilinear and uniform. A ball observes this law more nearly when rolled along the horizontal ground which supports its weight, than when projected through the air, where gravity causes a perpetual deflection, and more nearly on the ice which is smooth, than on the pavement where the friction is considerable. We conclude, that if the resistance of the air and of friction, and the action of gravity, were completely removed, the law would obtain with perfect accuracy. This is a proof more immediately from experience.

Farther, by assuming this law and reasoning from it, we arrive at conclusions which agree still more nearly with observation, because they refer to cases in which the causes of deviation have less influence. This holds remarkably with regard to the motions performed in vessels emptied of air, and likewise the celestial motions which seem to be performed in free space.

Thus the first law is proved partly by reason, partly by experience, and partly by its success, when assumed as a principle of philosophy.

It is worthy of remark, that even the first and last of the three proofs are founded also on experience, though more remotely than the second. Thus in the first proof we reason from the nature of matter, but that nature we had learned only from experience. In the last proof we assume the law, and apply it to the phenomena of nature, but the success of this assumption is ascertained only by experience. Indeed, it is evident, that all our knowledge of external nature must be from this source, either directly or indirectly through a process of reasoning. To say that this law enters into our very idea of matter, that it is a law of human thought, and that to suppose the contrary, would be to deny that matter is matter, does not alter, in the smallest degree, the foundation of the evidence; for granting that such were our idea of matter, whence did we derive it unless from experience? If philosophers chuse to set out with defining matter as a substance that possesses the property mentioned in this law, it is well; but still no application could be made of the law till we had learned from experience that such a substance existed.

Besides, it is evident, that though the resistance which matter offers to motion, or the effect it produces on any of our senses, might be sufficient to give us a general idea of matter, or to constitute its definition, yet, notwithstanding this idea, we could conceive matter to have obeyed a law very different from that under discussion. The circumstance that this law was unknown to the ancients, and is a discovery of very modern date, is a striking proof of what we have advanced. The first part of the law indeed which relates to rest, is abundantly obvious, because instances of apparent rest, at least, are continually presenting themselves. That part which relates to motion is rather contrary to first appearances, because, in consequence of retarding and deflecting causes, we never meet with an instance of motion perfectly uniform and rectilinear. But though the whole were a matter of vulgar observation, it would be proper to direct upon it a cautious and philosophical eye. If the facts on which it rests are so very obvious, their
evidence cannot surely be impaired by inquiry. First impressions often need to be corrected by subsequent reflection. Even some of the common axioms of geometry have been contested. Much more must the first principles of physical science be open to discussion. It was held as a first principle by Aristotle, that the earth is at rest merely because it appears to be so, and it required nearly two thousand years to show that this principle is false.

Second Law, or Law of Several Forces.

The effect is always proportional to the force impressed, and takes place in the direction in which the force acts; or, more precisely, provided the force exerted is the same, the effect of its momentary action is the same, whether the body was previously at rest or in motion, and whether it is acted on by that force alone, or subjected at the same time to the action of several other forces; so that the effect of the joint action of several forces is an exact compound of their separate effects, or the same as if each had acted successively. Thus the effect of two forces at once on a body in the same direction, is equal to the sum of their single or separate effects, &c.

This is a proposition which cannot be deduced either from the general definition of matter, or from the first law. We can infer, indeed, that when the body is acted on by several forces, the motion that ensues must be uniform and rectilinear; for, though urged in several directions, it can set only in one direction, and in whatever direction it sets out, it must continue to move uniformly by the first law.

This seems to be the amount of what can be proved by reasoning from the general principles. The particular direction in which the body shall set out, depends in many cases on the effect of each force; and that this effect would be the same as when the force acted alone, could be gathered only from experience. To say that this law is a mere affair of definition, and that in all cases we measure a force by the effect which it is found to have produced, whether alone or in combination, seems to be very unphilosophical. We measure a force by the effect which we find it has produced in a given case; (the more nearly the body was at rest, and the less under the influence of other forces the better;) but experience alone could inform us, that the measure deduced in this case would exactly agree with the effect of the same force in all other cases. If, indeed, the influencing circumstances in all other cases were the same; we would be justified in concluding that the effect would be the same. But how could we know unless from experience, that the circumstance of other forces acting in combination would not be an influencing circumstance?

Analogue experience could by no means have led us to the conclusion. We find that a very slight difference of circumstances is sufficient to change the mechanical action of bodies. We find that at sensible distances bodies attract, while at insensible distances they repel one another, so that a mere difference of distance, less than the millionth part of an inch, is sufficient to change the action from attraction to repulsion, that is, from one direction to another directly opposite. We find in chemistry, that two bodies, which separately burn animal matter, yet in a state of combination exert no such action. How could we know unless from experience, that in the case of forces also, the qualities of the ingredient are not in a great measure lost in those of the compound? In estimating the effect on the body, we have a difficulty in abstaining from the notion that the body has been immediately under the influence of all the forces; but we should consider that an event has intervened, that a new single action has arisen from all the separate actions, that it is only a knowledge of this action which can enable us to calculate the effect, and that this action can be learned only by experience. Many attempts have been made to demonstrate the law, but the view given above is sufficient to show that such attempts must be fruitless. The same conclusion is suggested, when we carefully analyse the most celebrated of these pretended demonstrations. The general definition of matter, and the first law, are found to be totally inadequate to conduct to the second. The mathematician, labouring under the burden of his task, finds himself, at every step, obliged to make assumptions of the same nature as the proposition to be proved. Thus lately, Dr Olynthus Gregory, in his valuable work on mechanics, (p. 16.) first assumes, that when forces act in the same direction, the result is obviously equal to the sum of the separate effects, and when in opposite directions, equal to their difference. He, indeed, wishes to give this principle the air of demonstration, by referring to the definition of force, and the third law of motion. But it has appeared already that the mere definition is quite insufficient, and, as to the third law, it is perhaps even less obvious than the second. Having made this assumption, he advances with its aid to the case of two forces acting at an angle. But he has not gone far, when he is obliged to make another assumption, viz. that "if to a material point already kept in equilibrium by a system of forces, another system is applied also in equilibrium, this will not destroy the pre-existing equilibrium." This is by no means manifest, from the general definitions of force and of body. It is a second assumption of the very same nature as the proposition to be proved. It assumes that the action of forces will not be altered by their composition with other forces. It is in fact a case of the law in question; nor is it a case either more obvious to reason, or more easily confirmed by experience, than many other cases. Other assumptions of exactly the same nature are drawn in as he advances, and yet he professes to tread in the path of the celebrated D'Alembert, and even to improve upon his demonstration, after it had been already improved by Franconur.

There is an illusion on this point, arising from our mathematical habits. In pure geometry, the length of the reasoning that conducts us to the conclusion, does not in the least impair the certainty of that conclusion, or our conviction of its truth. Each previous step being certain, the last must be certain also. We are apt to have the same opinion of physical science; but in doing so we shall often be egregiously mistaken. If the principle from which we set out is doubtful, the conclusion must be at least as doubtful, however pure our subsequent reasoning, and however free it may have been from other assumptions. But if, at a number of stages in the reasoning, we assume other doubtful principles, the conclusion must depend on the chance that all these principles are true, and is therefore probably much more doubtful than any of them; just as in throwing a die there is much less chance for an ace in each of ten successive throws, than in one throw. If we labour so much to shew that this law is indemonstrable, it is not because we undervalue the force and advan-
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Laws of
Motion.

The Third Law of Motion.

When one body acts on another, the other exerts an equal force against it in the opposite direction, which is usually expressed by saying, that action and reaction are equal and contrary.

This law holds whether the bodies attract or repel one another, and whether they act at a distance or in apparent contact; and the grand basis on which it rests is experience.

Thus, if one body attracts another at a distance, the other attracts it with equal force in the opposite direction; so that, if motion ensues, the quantity of motion produced in the one is equal to that produced in the other; and, if motion is prevented, the pressure necessary to prevent it in the one, is the same as in the other.

If one body repels another at a distance, the other repels it with equal force in the opposite direction, the equality of force being estimated in the same way as above.

The same law holds when the bodies act in apparent contact. In this case, if they attract, you have no greater reason to ascribe the force with which they cohere, or which is necessary to separate them, to the attraction of the one than of the other; if they repel, as in impulse or pressure, the reaction seems to be intimately connected with our first conceptions of matter. When one body strikes against another at rest, without producing motion, the same change is induced on the striking body, as if it being fixed had been struck by a body of equal mass and velocity in the opposite direction; and if it be the hand that strikes, the same sensation is experienced. These circumstances imply an equal reaction. If two bodies meet when moving in opposite directions, with equal momenta or quantities of motion, we may presume they will stop one another; for, equal momenta being the effects of equal forces, may be supposed to possess equal forces, and such will balance one another. This is actually the case. It appears from this that a force will be able to destroy just as much motion as it can communicate, and hence that it may be measured by either of these effects. If a body strike another at rest, or moving before it in the same direction, we may expect from the analogy of the last case, that the reaction will be equal to the action. We accordingly find that the quantity of motion which the impinging body has communicated is equal to what it has lost, that is to what the other by its reaction has destroyed. If the bodies move in opposite directions, we may presume that the body with the greater momentum will prevail, that it will first spend some of its motion in reducing the other to rest, and then some of the remainder in moving the other, and that in both parts of the process the reaction will be equal to the action, according to the two foregoing cases. This is also really the case. The same holds in all analogous cases, when bodies press against one another. If the bodies, in consequence of meeting, alter their shape, and again recover it, they will act on one another during the recovery, and then also the action is mutual and equal.

The same law may be expected to hold, and actually holds, when one body acts on another through the medium of a third, as when one body pulls another by means of a thread, or repels it by means of a pole. In this case the third body is merely a medium of communication, and cannot be supposed to alter the action of the forces, unless that its mass when considerable would need to be taken into the account.

SECTION III.

Composition of Forces.

A body is often acted on by several forces at once, and it is required to find the effect of this joint action, or a single force which would produce the same effect. This single force is called the equivalent, resulting, or compound force; and the process for finding it is called the composition of forces. The whole depends on the second law of motion.

CASE I. Two forces applied at the same point of a body.

—If they act in the same direction, the equivalent will be in that direction, and equal to their sum; if in opposite directions, the equivalent will be in the direction of the greater, and equal to this difference; if at an angle, the equivalent will be in the same plane, and represented by the diagonal of a parallelogram of which the two sides represent the simple forces.

This follows immediately from the second law of motion; the only case which needs any demonstration is that when the forces act at an angle.

If the one force alone would make the body move along AB, and the other along AC in the same time, CCXL. the two by their joint action will make it move along the diagonal AD in the same time.

For by the second law, its motion parallel to AB will be equal to AB, and its motion parallel to AC will be equal to AC; hence at the end of the time it must be at D. In like manner, suppose that by the separate action of the forces, the body would at any intermediate point of time be at E and F, then completing the parallelogram FE, their joint action will bring it to G at that time. But it is easy to see that AB : AE : : AC : AF. For both motions being uniform, first law of motion, the spaces past over in both cases are proportional to the times, and hence proportional to one another. Hence the two parallelograms are similar, and consequently about the same diagonal. (Enc. xxxvi. G.)

If the forces are pressures, the effects of the momentary action will be extremely small, but the same demonstration still applies. Though equilibrium is not
The direct object of this article, yet the following remarks may not be improper, as tending to illustrate the subject. If no motion ensues, still the diagonal will express the tendency to move, as well as the direction of that tendency. It will express the force applied in the contrary direction, which has destroyed the motion, whether that force be an active one, or merely the reaction of a fixed obstacle. In the case of pressures, it will express the pressure that arises against the obstacle; a conclusion which we are justified in drawing from the analogy established in the first Section between pressures and the motions which they generate, and which, besides, is confirmed by experience. The case of impulses is illustrated in some treatises of natural philosophy, by a complex piece of machinery. The case of pressures may be illustrated by the following simple apparatus.

Let the three weights hang around the two fixed pulleys, as in the Figure, be in a state of equilibrium; let AB, AC, be taken proportional to the weights N, M, respectively, which act in the directions of AB, AC; then the parallelogram being constructed, the diagonal AD, which is the equivalent according to our proposition, will be found to be vertical, that is directly opposite to P, and also proportional to P.

Con. 1. The equivalent is represented by the third side of a triangle, whose other two sides are drawn in succession parallel and equal to the single forces. This is evident by inspecting the triangle ABD. It is evident also, that the included angle of this triangle is the supplement of that at which the forces act.

The sides of any triangle perpendicular respectively to those of ABD, will also express the magnitudes of the forces, and of their equivalent; for such a triangle will be similar to ABD.

Con. 2. Given two forces and the angle which their directions make, the equivalent may be found either by constructing the parallelogram, or the triangle, or by trigonometrical calculation. The angle BAD being found, will express the direction of the equivalent.

It is easy to show by help of Eucl. 12, 13. 2. that if $a, b$ denote the two forces, $c$ the angle which they make, and $d$ their equivalent,

Then $d = \sqrt{a^2 + 2ab \cos c + b^2}$, the radius being unity; also the sine of the angle which $d$ makes with $a$ is $\frac{a \times \sin c}{d}$.

It is easy to see from 47. 1 Eucl. that if the angle is right, then $d = \sqrt{a^2 + b^2}$.

Con. 3. When the two forces act at an angle, the equivalent is less than the sum, and greater than the difference; and it is more nearly equal to the sum the smaller the angle, so that when the angle vanishes it will become equal to the sum.

This is evident from the properties of a triangle.

Con. 4. The simple forces are inversely as the perpendiculars dropped on their directions from any point in the direction of the equivalent.

1st. If dropped from D, the $\triangle ACD = \triangle ADB$, hence $AC \times DM = AB \times DN$. Therefore $AC : AB : : DM : DN$.

2d. If dropped from any other point G, it is easy to see by similar triangles, that $DN : DM : GE : GF$; hence $AC : AB : : GE : GF$.

Case 2. Any number of forces applied at a point.——The equivalent will be found by compounding two according to last case, then compounding the equivalent with a third, and so on.

If all the forces lie in one plane, it is evident that the most expeditious way of finding the equivalent will be by drawing successively lines equal and parallel to those representing the forces, as in Figure; and then the line drawn in completing the polygon will be the equivalent.

The equivalent of three forces is the diagonal of a parallelopid, of which the three forces are the adjacent lineal edges.

$AB, AC, AD$ being the three forces applied at A, the diagonal AE will be the equivalent.

For joining BE, AG, the equivalent of $AC, AD$ is $AG$, because $AC, AD$ is a parallelogram, and since the plane in which the parallels $AB, EG$ are, is cut by parallel planes, the lines of common section $BE, AG$, will be parallel, (Eucl. 16. 11.) hence the Figure BG is a parallelogram, therefore $AE$ is the equivalent of $AB, AG$, that is of $AB, AC, AD$.

It is easy from the Figure to perceive, by help of (Eucl. 47. 1.) that if the parallelopid is rectangular, and if $a, b, c$ denote the three simple forces, and $d$ the equivalent, then $d = \sqrt{a^2 + b^2 + c^2}$.

Case 3. Two parallel forces applied to different points of a body in the same direction.——Since the two parallels may be considered as coming from a point infinitely distant, or as making an infinitely small angle with one another, their equivalent will be equal and parallel to their sum by Cor. 3. to Case 1, and it will divide the straight line joining the points of application in the inverse ratio of the forces.

For by Cor 4, the forces are inversely as the perpendiculars on their directions, which, in this case, are as the segments of the joining line. The Figure is sufficient to show this.

Case 4. Two parallel forces applied in opposite directions.——The equivalent will be equal to their difference, in the direction of the greater, on the other side of it, and divide the straight line produced through the points of application in the inverse ratio of the forces.

This will follow from last case; for let NA be a force which, together with CD, balances FE, or, in other words, which prevents the line AD from moving, then, by last case, $NA + CD$ must be $= FE$, and CD being to NA, $AE : ED$, CD will be to FE, as $AE : AD$; but since NA keeps the line from moving, it must be equal and opposite to the equivalent which we are seeking; hence, if $AG = AN$, what we have demonstrated of AN will hold of AG.

Case 5. Any number of parallel forces.——Compound two, then the equivalent with a third, and so on. If some act in one direction, and others in the opposite, it will be most convenient first to compound all those in one direction, and then all those in the opposite; and, lastly, compound the two equivalents. It is easy to see from the nature of the process, that the point through which the last equivalent must pass will be the same, so long as the forces and points of application are the same, although the direction of the forces should be changed. This remarkable point is called the centre of parallel forces.

Case 6. Forces applied to different points, but not parallel.——If they are in one plane, you may produce them till they intersect, and then compound them two and two. If they are not in one plane, but converge toward one point, you may consider them all as applied at that point, and then find their equivalent, as in Case 2. If they do not converge toward the same point, the case requires the reduction of forces, and will be explained under Art. 4. of next Section.
SECTION IV.

Resolution of Forces.

This consists in resolving a single force into others to which it is equivalent, and which are to have given directions.

1. If the given directions are all in the same plane with that of the given force, we can always perform the resolution into any number of forces, by inverting the process of Case 1, last Section.

Thus, if two, we will make a parallelogram, of which the diagonal represents the given force, and the sides are parallel to the given directions. If three, we may first resolve a part of the given force into two of the given directions, and then the remainder into one of these directions, and the third direction.

2. When the given directions are not in the same plane with that of the given force, we cannot resolve it into two, but we can always resolve it into three given directions, provided two of them are in one plane. We can first resolve it into two forces, one of which is parallel to one of the given directions, and the other parallel to the plane of the other two; and then resolve this other into the other two given directions.

3. One important application of the resolution of forces, is to find the effect of a force in a given direction, or in other words, to reduce it to a given direction.

It is evident that, in order to do this, we have only to resolve the force into two, one of which is parallel to the given direction, and the other at right angles to it. The latter can have no effect in the given direction, and therefore the other will express the whole effect.

4. Another important application of this subject is to the composition of forces.

The last case of composition cannot be managed unless by resolution. You may fix on three directions, two of them in one plane; resolve each force into three, parallel to these directions, find the equivalent of all those parallel to one line, then of those parallel to another, &c. then compound the three equivalents, if they pass through the same point; if not, the problem is impossible, that is, there is no single force equivalent to them all.

The most convenient directions to fix on will be three straight lines passing through the same point at right angles to one another, and the most convenient way of resolving, will be to calculate on the principle mentioned in Case 2d of last Section, that the three adjacent edges of a parallelopiped compose a force equal to the diagonal. Hence, since in this case the parallelopiped is rectangular, let $\mathbf{F}$ denote any force.

Then $R \cdot \cos \alpha \cdot f \cdot \frac{1}{\sin \alpha} = \text{the force estimated in that direction.}$

Let $b, c, d, e$ denote the three equivalents found; then, if they pass through the same point, they will be three edges of a rectangular parallelopiped, of which the diagonal is the equivalent sought, which call $m$; then $m = \sqrt{a^2 + b^2 + c^2}$. The same method may be applied with advantage to Case 2d of composition, when the forces are not all in one plane; and even when the forces are all in one plane, a similar method will sometimes be convenient, only in that case it will be sufficient to resolve each force in the direction of two perpendicular lines. It is evident that in Case 2d the composition can always be effected, because the three equivalents will always pass through the point to which all the given forces are supposed to be applied.

SECTION V.

Application of the General Principles of Dynamics to some Cases in which the bulk of the Body is overlooked, or rather in which the Body is regarded as having its whole Matter collected in a Point.

CASE 1. A body acted on by an impulsive force.—By the first law, the motion will be uniform and rectilinear.

Hence, if $v$ = the velocity, or space through which the force will make the body go in a certain unit of time, $t = \text{the whole time or number of units during which the body moves}, s = \text{the whole space or line passed over},$ it is evident that

$$s = vt.$$

This is the fundamental equation, which involves all the rest.

Thus $\frac{s}{v} = t$.

Hence also $s = \frac{1}{v}$ when $s$ = the same, and $s = \frac{1}{v}$ when $t$ = the same.

$\frac{s}{v} = t$ when $s = \frac{1}{v}$ when $t$ = the same, and $s = \frac{1}{v}$ when $t$ = the same.

CASE 2. A body acted on by two impulsive forces.—If they act in the same direction, the velocity will be equal to the sum of the separate velocities.

If in opposite directions, it will be equal to their difference.

If at an angle, the velocity and direction will be found by the rule given for finding the equivalent of two forces, in last Section; that is, by finding the diagonal of a parallelogram, of which the sides represent the separate velocities.

CASE 3. A body acted on by an equal impulsive force at equal intervals of time in the same direction.—Suppose the force is such, that during the first interval of time the body will pass over the space $a$.

With this velocity it would go on uniformly, but at the end of the interval it receives an equal impulse, which, according to the 2d law, will just add as much to its velocity, and so on; hence during the second interval, it will pass over the space $2a$; during the third, $3a$, &c.; so that if $t$ denote the whole time, or whole number of intervals, it will, during the $t^{th}$ interval, pass over the space $ta$.

Hence it is evident, that the velocity at any period of the motion will be in proportion to the number of intervals, or to the time that has elapsed.

The whole space will be $= \text{the sum of the arithmetic progression } a, 2a, 3a \ldots \begin{cases} \frac{a}{2} + \frac{a}{2} = a \times \frac{t + 1}{2} \end{cases}$.
Con. 1. If \( t \) the number of intervals is very great, then \( \frac{a}{t} \) will be very great in comparison with \( t \), so that the space will be \( \frac{a t^2}{2} \) nearly.

Con. 2. Hence, too, in this case, the space will be nearly proportional to \( t^3 \), since \( a \) and \( t \) are constant.

Con. 3. The space over which the body would go with the last acquired velocity in the time \( t \) would be \( t a \cdot t = t^2 a \), nearly double the space already gone over, if \( t \) is great.

Case 4. A body acted on by pressure, always acting in the same direction, and with the same intensity.

When once a body has acquired a finite velocity, by the action of an unremittting force, and the action has ceased, the motion (according to law 1st.) will be perfectly uniform, and therefore all its circumstances calculated as in Case 1. But in the present case, a considerable time elapses before a considerable velocity is acquired, and it is interesting to investigate the circumstances of the motion during the lapse of that time.

The action being renewed at the end of every instant, the velocity will not remain the same longer than an instant, or the motion will be perpetually accelerated.

The velocity at any point is expressed by the space passed over during the next instant, or by the space it would pass over during the next unit of any magnitude, were it to preserve its motion unaltered, or nearly by the space actually passed over during the next moment.

When the force is supposed to act with the same intensity, the velocity added at the end of each instant will be the same; and hence if \( t \) denote the number of instants in any finite portion of time, and \( v \) the velocity acquired, it follows by the demonstration in last case, that \( v = \frac{1}{t} \). Also, since in this case \( t \) is infinitely great, \( s = \frac{t^2}{2} \) exactly.

but \( v = \frac{1}{t} \); hence \( s = \frac{v}{t} \).

For the same reason, in this case, the space through which the body will go with the last acquired velocity in the time \( t \), will be exactly twice the space it has already gone over.

Con. 1. In the case of any pressure, having ascertained by experiment the space passed over in a certain time, such as a second, we will have the space that would be passed over during the next unit with the motion unaltered, that is, the velocity acquired, and we will be able, given any one of three \( t, v, s \), to find the other two.

Thus we will be able to find \( s \) when \( t \) is given, or \( t \) when \( s \) is given, by the formula \( s = \frac{t^2}{2} \).

We will find \( v \) when \( t \) is given, or \( t \) when \( v \) is given, by the formula \( v = \frac{1}{t} \).

And we will find \( s \) when \( v \) is given, or \( v \) when \( s \) is given, by the formula \( s = \frac{v^2}{2} \).

Or an absolute equation may be derived, for each of the six problems that may arise. Thus, let \( p \) be the space passed over during the first unit of time, and consequently \( 2p \) will be the velocity acquired during that time.

Then \( 1 : p : : p : s = p \cdot t^2 \).

Hence \( \sqrt{\frac{s}{p}} = t \).

\[ 1 : t : 2 p : v = 2 p t \]

Hence \( \frac{v}{2p} = t \).

\[ 4p^2 : v^2 : : p : s = \frac{v^3}{4p} \]

Hence \( 2 \sqrt{\frac{p}{s}} = v \).

Con. 2. \( s = \frac{v}{t} \), and consequently \( \frac{s}{p} = \frac{t}{t} \), and \( \frac{v}{v} = v \).

Con. 3. If the times, counting from the beginning of the motion, are taken as 1, 2, 3, \&c. the spaces will be as 1, 4, 9, 16, \&c. and the spaces passed over during the successive equal intervals of time, will be as the differences of these numbers, that is, as the odd numbers 1, 5, 7, \&c.

Con. 4. Since with the same pressure, the velocity acquired is proportional to the time, in comparing two pressures, we will obtain the same ratio, whatever be the time we assume. This shews the consistency and propriety of the measure we adopted.

Con. 5. If one of the two pressures produce the same velocity in the same body in half the time, it is evident it would, in the same time, produce double the velocity; hence the force would be double, and so on. Therefore, when the mass and the velocity, or \( m \) and \( v \) are the same, then \( f = \frac{1}{t} \). Hence we have \( f = \frac{m v}{t} \), or \( f = \frac{m v}{t} \), if we measure \( f \) by the effect in an unit of time.

Con. 6. Again, since \( v = \frac{2s}{t} \), if we substitute the latter in the expression of the foregoing corollary, we get \( f = \frac{2m s}{t} \).

Con. 7. Also, since \( t = \frac{2s}{v} \), if we substitute the latter, we get \( f = \frac{m v^2}{2s} \).

Con. 8. Further, it may sometimes happen, that we do not know the circumstances of a motion from its commencement, and we may wish to determine the force by observing the increments on the time, space, or velocity.

Now, it is easy to shew that the above formula will apply to the increments, reckoning from any point, as well as from the beginning.

Thus, let \( v, t, s \), denote the corresponding increments on \( v, t, s \).

Since \( v = \frac{t}{t} \), hence \( \frac{v}{t} = \frac{v'}{t'} \).

Therefore \( f = \frac{m v'}{t'} \).

Since \( s = \frac{t^2}{2} \), hence \( s = \frac{s'}{t'} \).

Therefore \( f = \frac{2m s'}{t'} \).

Since \( v = \frac{s}{t} \), hence \( \frac{v}{t} = \frac{v'}{t'} \).

Therefore \( f = \frac{m v'}{2s'} \).

Con. 9. When the mass remains the same, the force will be measured by the velocity generated in the unit of time; and the expression for it will evidently be had by dividing the above formula by \( m \), or by expounding it.

Con. 10. If the force continually increases, the velocity will increase faster than in the ratio of the times, and the spaces faster than in the ratio of the squares of the times. The reverse will hold, if the force continually diminish.

Case 5. A body acted on by pressure, always in the same direction, and continually varying its intensity according to a certain law. Here, as in last case, the motion being uniform only for an instant, it will follow by
In a similar manner, since by last case \( f = \frac{(v^2)}{2s} \), it follows that in this case \( f = \frac{2v^2}{2s} = \frac{v^2}{s} \).

Also since by last case \( f = \frac{2s}{v^2} \), hence in this case \( f = \frac{2s}{v^2} \).

Farther, since \( i = vi' \), and consequently \( v = \frac{i}{t} \), therefore taking the fluxions of these quantities \( v = \frac{s}{i} \), substituting this instead of \( v \) in the second formula, we get \( f = \frac{s}{i} \), which becomes \( f = \frac{s}{i} \) when \( i \) constant.

Hence, bringing together all the formulæ necessary in the present case, we have

1. \( s = s' \), hence \( \frac{s}{s} = i \), and \( \frac{s}{i} = v \)
2. \( f = v \), hence \( f = t \)
3. \( f = \frac{v^2}{s} \), hence \( f = \frac{v^2}{s} \).
4. \( f = \frac{s}{i} \), hence \( f = \frac{s}{i} \).
5. \( f = \frac{s}{i} \), which becomes \( f = \frac{s}{t} \) when \( i \) constant.

These formulæ may be employed either for finding the relations of \( s, v, \) and \( t \), when you know the law of the force, expressed according to some function of one of them; and, conversely, you have only to substitute the given relation in the proper formula, and then integrate. The law of the force is commonly expressed according to some function of \( S \); the two following problems will involve almost every thing that can be desired on this subject.

**PROB. I.**

Suppose that the force varies as some given power of the distance from a point toward which the body is moving, and which we may call the point of attraction, it is required to determine the relations of the space passed over, the time elapsed, and the velocity acquired, so as to enable us to infer one from another.

Let \( s \) = the distance of the body from the point of attraction at the outset, 
\( s' \) = the space it has past over, 
\( v \) = the velocity acquired, 
\( t \) = the time elapsed, 

then \( a - s \) will be the distance now from the point of attraction, and \( a - s \) multiplied by some constant quantity, which we may call \( m \), will be the force that now acts on the body. It is evident that in any case \( m \) will be known when we know the force at some given distance.

To discover the relations of \( v \) and \( s \), we will substitute the expression for the force, in the third formula, where \( v \) and \( s \) occur.

Hence \( m \times (a - s)^{n+1} + C = v^2 \).

Now the constant quantity \( C \) must be such that \( v = 0 \) when \( s = 0 \), hence \( C = \frac{m(a^{n+1})}{1} \).

Hence \( m \times (a - s)^{n+1} - ma^{n+1} = v^2 \).

This applies whether \( n \) be positive or negative, whole or fractional, unless when \( n = -1 \). In this case, the formula is evidently absurd, and in order to have the proper fluents, we must recur to the fluotion equation, which becomes \( m \times (a - s)^{n+1} \times s = v^2 \).

Hence, taking the fluents, and employing \( L \) to denote hyperbolic logarithm, we get \(-m \times L (a - s) + C = \frac{v^2}{2} \).

The constant quantity \( C \) must be such that \( v = 0 \) when \( s = 0 \), hence \( C = m \times L, a \).

Consequently \( m \times (L, a - L_1, (a - s)) = \frac{v^2}{2} \).

Thus, \( m \times (L, a - L_1, (a - s)) = \frac{v^2}{2} \).

Again, to discover the relations of \( s \) and \( t \) in any case, we have only by the above formulæ to find the expression for \( v \) in terms of \( s \), and substitute that expression instead of \( v \) in the fundamental equation \( \frac{s}{v} = t \). We will thus have a fluxional equation involving the fluotions of \( s \) and \( t \) with known terms, and taking the fluents, we will obtain an equation involving \( s \) and \( t \) themselves with known terms.

Thus, \( n = -2 \), which is one of the most interesting cases, then

\[ v = \sqrt{2m \times (a - s)^{a^2} - s^2} \]

Hence \( t = \frac{s}{\sqrt{2m \times (a - s)^{a^2} - s^2}} \), on multiplying each term of the last fraction by \( a - s \).

Hence \( t = \frac{s}{\sqrt{2m \times (a - s)^{a^2} - s^2} \times a} \times \frac{a - s}{a - s} \times s \).

Now the last part of this expression, viz. \( \frac{a - s}{\sqrt{a - s^2} \times s} \), is evidently equal to \( \frac{a - s}{\sqrt{a - s^2} \times s} + \frac{a - s}{\sqrt{a - s^2} \times s} \), the first term of which has for its fluent \( \sqrt{a - s^2} \), and that
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Application of the second (by supposing \( s = \frac{a}{2} - z \)) will be \( \frac{a}{2} \times \text{an} \) arch whose cosine is \( \frac{2z}{a} - \frac{a}{2} \).

Hence \( t = \sqrt{\frac{a}{2m} \times \left\{ \sqrt{a^2 - s^2} + \frac{a}{2} \times \text{arch} \right\}} \) and this case requires no correction, because \( s \) must be \( 0 \) when \( t = 0 \).

Con. 1. When \( s = a \), then \( v \) is infinite, and \( t = \sqrt{\frac{a}{2m} \times \frac{ac}{2}} \) where \( c \) is the circumference of a circle whose diameter is unity; hence the whole time of descent to the centre of attraction by a body setting out at different distances is \( \frac{a}{2} \sqrt{a^2 - a} \), that is proportional to the square root of the cube of the distance.

If the force varies as some given power \( n \) of the distance from a given point farther back, than that from which the body sets out, the equation that expresses the relation of \( v \) and \( s \) will be the same as before, only having \( n+1 \) instead of \( n \).

Con. 2. Hence, if the body is acted on by several pressures in the same or opposite directions, the effect may be found by calculating the separate effects, and then taking the sum or difference.

Problem II. Suppose that the relation between \( t \) and \( s \) is given; suppose, for instance, that \( t = \frac{a}{a-s} \), and consequently \( s = m \times a \times a \times d^3 \), \( m \) being a known quantity, required the law of the force expressed according to \( t \).

Since \( f = \left( \frac{s}{i} \right) \)

if we regard \( s \) as constant, we get \( f = \frac{s}{t^3} \).

Now \( t = \frac{m \times (a-s)^n}{d^3} = \frac{n m \times (a-s)^n}{d^3} \),

hence \( t^3 = \frac{n^3 m^3}{d^3} \times (a-s)^{3n} \).

and \( f = \frac{n m s^3 \times (n-1) \times (a-s)^{n-2} \times -s = \frac{n m s^3 \times (n-1) \times (a-s)^{n-2}}{n^2 m^2} \).

hence \( f = \frac{n m s^3 \times (n-1) \times (a-s)^{n-2}}{n^2 m^2} \).

Here \( f = (a-s)^{1-n} \).

The great object in this case of dynamics is, given the relation of the force to \( s, v, \) or \( t \), to find the relation of these to one another, or, given the relations of two of these to find the relation of the force to them. The relation most easy to observe, is that of the force to \( s, \) or of \( s^2 \) to \( t \).

Case 6. A body acted on by impulse and pressure at the same time.—It is necessary to bear in mind, that the impulse ceases to act almost immediately, but that the pressure continues to operate. It is evident that the effect will be the same, as if the body had acquired a finite velocity in any other manner, and then begun to be acted on by the pressure.

Variety 1. When the impulse and pressure both act in the same direction.—It is clear that the motion will be in that direction, and that the effect in any given time will be found, by calculating separately the effects of the impulse and pressure, and adding them together.

Variety 2. When the two forces act in opposite directions.—It is evident, that the motion will be continually retarded, and at last destroyed. To find the relations of \( s, v, \) and \( t \), you have only to calculate the effect of the initial velocity, supposing it to remain the same, and then subtract the effect of the pressure. To find the time in which the whole initial velocity will be destroyed, or the body brought to rest, we have only to calculate in what time the pressure would be able to generate that velocity. It is evident, that if the pressure acts always with the same intensity, the motion will be uniformly retarded, or the body will lose equal portions of velocity in equal times; also, the whole time will be proportional to the initial velocity, and the whole space proportional to the square of the whole time, or of the initial velocity. Thus, it is evident, this variety of Case 6th will come within the range of former problems.

Variety 3. When the impulse and pressure act at an angle.—This is by far the most important and most difficult variety, and is usually discussed under the title of Central Forces.

If a body, already proceeding with a finite velocity, in consequence of an impulse, or some other cause, is acted on at finite intervals of time by new impulses, each of which differs in its direction from that of the previous motion, its path will evidently be a succession of straight lines making angles with one another. If, instead of being an impulse, the force be pressure, and act incessantly, the straight lines will become infinitely short, and the path consequently become curvilinear. The curve will lie wholly in one plane, if the direction of the pressure be always in the same plane with the original direction of the motion, and it will be concave on that side toward which the pressure is directed. Again, since a body, if left to itself, moves in a straight line, we may conclude, when it moves in a curve, without being compelled to it by a fixed obstacle, that there is a force of pressure constantly deflecting it from the direction of the tangent.

The arch, through which the body moves in an instant, or through which it would move in any unit of time in the direction of the tangent, if the pressure were to cease, is the projectile velocity at that point of the curve.

In the cases that most commonly occur, the pressure is an attraction; it is commonly directed to the same point during a considerable part of the motion; that point is called the centre of attraction, and the force is called a centripetal force.

The force with which the body, in consequence of its projectile motion, endeavours to recede from the centre of attraction, is called a centrifugal force. These two forces have the general name of central forces.

A straight line, drawn from any point of the curve to the centre of attraction, is called the radius vector.

The angular velocity at any point of the curve, is the velocity with which the radius vector at that point describes an angle, that is, the angle which it passes over in an instant, or that which it would pass over in any unit of time, were its angular motion to remain uniform.

When the line which the body describes returns into itself, like a circle or an oval, it is called an orbit, and...
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Application. the time of describing the whole of it is called the periodic time.

The following are the most important propositions on the subject of central forces.

Prop. I.
If the centre of attraction remains always the same, the curve will lie wholly in one plane, passing through that centre; and the areas described by the radius vector, will be proportional to the times of description.

First, suppose the central force to act during equal finite intervals of time; suppose $c$ the centre of attraction, $AB$ the line passed over in one of the equal intervals, the body with its uniform motion would, during the next equal portion of time, go over a line $BD=AB$, but at $B$ it is acted on by the central force. Suppose the momentary action is such, that in the same time the body would move along $BE$, then completing the parallelogram, $BF$ will be the real line of the motion. Joining $CD$, the $\Delta ABC$ is $\approx \Delta BDC$, because they have equal bases, and the same altitude; and the $\Delta FBC$ is $\approx \Delta BDC$, because they are on the same base, and between the same parallels; therefore, $ABC=FBC$. The same thing may be shewn with regard to the next triangle, &c. Hence, the sum of all the triangles, or the whole area, described in a given time, will be proportional to the time of description. Also, all the triangles are in one plane; for $CFH$ is in the plane of $CDB$, since they are between two parallels which necessarily lie in one plane, and $CDB$ is evidently in the plane of $ABC$; therefore $CFB$ is in the plane of $ABC$. It is clear, also, that the point $C$ must always be in the plane of the Figure. Suppose now that the central force acts incessantly, or that the equal intervals of time are infinitely small, the path then becomes a curve, and the triangles become infinitely small, but still the same demonstration will hold; and hence we infer the proposition.

Conversely.—Prop. II.
If the curve described lie wholly in one plane, and the radius vector drawn from a certain point in the plane, always describe areas proportional to the times, that point is the centre of attraction.

For around any other point than the centre of attraction, the areas described in equal times cannot be equal.

Thus, in the same Figure, take any other point $G$; it is evident that $GBF$ cannot be equal to $GBA$; for in order that this might hold, $DF$ would need to be parallel to $GB$, whereas it is parallel to $CB$.

Prop. III.
The projectile velocity at any point of the curve is inversely as the perpendicular let fall on the tangent at that point from the centre of attraction.

For the small triangle described in an instant, by the radius vector being everywhere of the same area, its base must be inversely as its perpendicular; but the base is the projectile velocity, and the perpendicular on the base is just the perpendicular on the tangent.

Prop. IV.
The angular velocity is inversely as the square of the distance or of the radius vector.

Let $ACB$ be the small triangle described in an instant, and therefore the angle $C$ the angular velocity.

From the nature of the circle, the angle $C$ is $= \frac{AD}{AC}$; but the area of the triangle described in an instant being always the same, the perpendicular will be inversely as the base; hence, $AD = \frac{1}{AC}$, because $AC$ is ultimately $= CB$; hence the angle $C = \frac{1}{AC^2}$; or let $a$ be the angular velocity, and $r$ the radius vector, then $a = \frac{1}{r^2}$.

Prop. V.
The centripetal force, at any point, will be proportional to the versed sine of the arch described in an instant, reckoning the versed sine toward the centre of attraction.

For the small arch $AD$ may be considered as the diagonal of the parallelogram $EB$, of which the side $AB$ expresses the effect of the projectile force, and $AE$ that of the central force.

Cor. 1. You may measure the centripetal force by the velocity generated in an instant, and then you will employ twice $AE$; but the ratio is of course the same. Cor. 2. $BD$, which is equal to $AE$, is the instantaneous deflection from the tangent, and may also serve to measure the centripetal force.

Circle.—Prop. VI.
Sectors of a circle being proportional to the arches on which they stand, when the body describes the circumference uniformly, the radius vector will describe the area uniformly; hence the centre of the circle must be the centre of attraction by Prop. 1. The converse follows in a similar manner from Prop. 2.

Prop. VII.
If the body describe a circle, the centripetal force at any point is directly as the square of the projectile velocity, and inversely as that part of the radius vector produced which the circle intercepts, often called the deflective chord.

Let $AB$ be the arch described in an instant, $BD$ $\parallel$ the tangent, $BD$ the tangent, $C$ the point of attraction, then $AD$ measures the centripetal force.

Joining $AB$ and $BE$, it is easy to see from similar triangles, that $AD : AB :: AB : AE$; hence $AD = \frac{AB^2}{AE}$.

But the chord $AB$ is ultimately equal to the arch, and therefore equal to the projectile velocity; hence, the centripetal force $= \frac{2}{2/3}$ vel.$^2$ centripetal force $= \frac{2}{2/3}$ deq. chord $^{\text{def. chord}}$

Prop. VIII.
If the body move uniformly in a circle, the centripetal force will be directly as the square of the projectile velocity, and inversely as the diameter.

For the centre of the circle will be the centre of attraction, (Prop. 6.), and hence the deflective chord will be the diameter. Hence, the Prop. follows from the last, $f = \frac{v^2}{r}$.  

Prop. IX.

If the body move uniformly in a circle, the centripetal force will be directly as the radius, and inversely as the square of the periodic time.

For in uniform motion, the velocity is proportional to the space divided by the time. Hence, let \( c \) denote the circumference, \( v \) the velocity, \( c = r \), but \( c \approx r \), therefore \( v \approx \frac{r}{t} \). Substituting this value of \( v \) in last Prop. we get \( f \approx \frac{r}{t} \).

Prop. X.

If the body move uniformly in a circle, the centripetal force will be directly as the product of the distance of the radius and the square of the angular velocity.

For let \( a \) denote the angular velocity. It is evident that \( t \approx \frac{1}{a} \) and \( t^2 \approx \frac{1}{a^2} \). Substituting this value of \( t^2 \) in last Prop. we get \( f \approx r a^2 \).

The four last propositions give us proportional equations, with regard to the revolution in a circle.

The two next afford us absolute equations, which are also of frequent use.

Prop. XI.

If the body revolve uniformly in a circle, the space through which it would move by the action of the centripetal force alone in any unit of time, such as a second, will be equal to the square of the radius described in the same unit, divided by the diameter, or twice the radius.

It appeared in Prop. 7, that the space through which the body would move in an instant by the action of the centripetal force, is equal to the square of the radius described in an instant, divided by the defunctive chord; which, in this case, is the diameter. But the space described in consequence of an attraction acting always with the same intensity, is proportional to the square of the time; and the motion in the circle being uniform, the arch described is proportional to the time; and, therefore, the square of the arch proportional to the square of time. Hence, the effect of the attractive force in any time is proportional to the square of the radius described in the same time; and, therefore, since the proposition holds in the case of an instant, it must hold in the case of any other unit; or \( f = \frac{v^2}{2r} \), the unit of time being the same for \( f \) and \( v \), but of any magnitude.

Con. 1. Of these three, viz. \( f, v, r \), any two being given, the third may be found.

Con. 2. The projectile velocity is equal to that which a body would acquire in falling through half the radius by the uniform action of the centripetal force.

For by the doctrine of accelerated motion, the velocity so acquired would be \( \sqrt{f \frac{v}{2}} = \sqrt{\frac{4r}{2}} \), and by the formula in this proposition, \( v = \sqrt{\frac{2r}{f}} \).

Con. 3. It is evident that this proposition, and the preceding corollaries, will apply to a circle described with a variable motion, if you substitute half the defunctive chord instead of radius, and the space that would be described in the same unit with an unaltered velocity, instead of the arch actually described.

Prop. XII.

If the body revolve uniformly in a circle, the space through which the body would move by the action of the centripetal force alone, in any unit of time, will be equal to twice the radius, multiplied by the square of the circumference of the circle whose diameter is unity, and divided by the square of the periodic time, or \( f = \frac{2 \cdot \pi \cdot m^2}{t^2} \), where \( m \) denotes the circumference of a circle whose diameter is unity, and therefore \( = 3.1416 \) nearly.

For the circumference of the given circle will be \( 2 \pi m \); and the motion being uniform, \( v = \frac{2 \cdot \pi \cdot m}{t} \), and \( v^2 = \frac{4 \pi^2 \cdot m^2}{t^2} \); but last Prop. \( f = \frac{v^2}{t} \); therefore \( f = \frac{2 \pi \cdot m^2}{t^2} = 19.739 \times \frac{r}{t} \) nearly.

Con. 1. Of these three, viz. \( f, r, t \), any two being given, the third may be found.

Con. 2. The periodic time is to the time of falling along half the radius by the uniform action of the centripetal force, as the circumference of a circle to the radius.

For, by the doctrine of accelerated motion, the time of falling along half the radius will be \( \sqrt{\frac{r}{2f}} \), and by the formula of this Prop. \( t = m \times \sqrt{\frac{2r}{f}} = m \times \sqrt{\frac{4 \pi^2 \cdot m^2}{t^2}} \). Hence the latter to the former as \( 2m : 1 \). This \( \frac{1}{2} \), that is, the circumference of a circle to radius.

Prop. XIII.

The centripetal force necessary to make a body describe a circle with the same angular velocity as it has in the different points of its orbit, of whatever form, is inversely as the cube of the distance from the centre of attraction.

For in circular motion \( f = \frac{r}{a^2} \) (Prop. 10.) and in any curve \( a = \frac{1}{r^2} \) (Prop. 4.) and \( a = \frac{1}{r^2} \), where \( r \) denotes the radius vector. Hence, \( f = \frac{r}{a} = \frac{1}{r^3} \).

Prop. XIV.

If one body describe a curve (BE) around a centre of attraction (c), and another descend toward that centre in a straight line (AC) by the mere action of the centripetal force, which is supposed to be the same at equal distances; and if in any two points (B, A) equidistant from the centre, the bodies have equal velocities, they will also have equal velocities in any other two points equidistant from it.

Take the indefinitely small arch BE. From C, as a centre, with the radii CB, CE, describe the arches BA, ED, the velocities at E and D shall be equal, for draw FG \( \perp \) BE.
The increments on the velocity, in describing these small spaces, will be as the product of the accelerating force by the time. Now, the velocities at A and B being equal, the times of describing AD and BE will be as the lines AD and BE. Again, the centripetal forces at A and B being equal, will be as the equal lines AD and BF; but the body at A is accelerated by the whole of the centripetal force; whereas at B, the centripetal force is to that which accelerates the body along the curve, as BF to BG; hence, the accelerations at A and B are as AD and BG. Hence, the increments on the velocities, in describing these small spaces, will be as AD$^2$ and BG$^2$; and therefore BG$^2$BE = AD$^2$. Therefore, the increments are equal, and consequently the velocities at D and E equal. Now, since, in making equal and infinitely small approaches toward the centre, the increments of velocity are equal, it follows that, in making equal finite approaches, the increments will be equal, and therefore the velocities acquired will be equal.

**Prop. XV.**

If the orbit which a body describes in consequence of a centripetal force, and which we may call the simple orbit, revolve from whatever cause in its own plane around the centre of attraction with an angular velocity, which bears a constant ratio to that of the body, the compound orbit which the body describes in consequence of this compound motion will be deflected toward the same centre of attraction.

For, in the compound orbit, the angular velocity of the body will be every where equal to what it had in the simple orbit, plus or minus the angular velocity of the orbit, according as the orbit revolves in the same direction as the body, or in a contrary one; hence (from the constant ratio mentioned in the enunciation) it is clear, that the angular velocity in the compound orbit will be every where proportional to the angular velocity in the simple orbit; but the angular velocity in the two orbits will evidently be proportional to the momentary increase of area, the distances being the same. Hence, the areas in the two orbits will increase at the same rate; but in the simple orbit, the areas are proportional to the times, (Prop. 1.) Hence this will also hold in the compound orbit, and hence this orbit may be considered as having the same centre of attraction, (Prop. 2.)

**Prop. XVI.**

The same supposition being made as in last proposition, the difference at any point between the centripetal force that acts on the body in the simple orbit, and that which acts on, or will be necessary to retain the body in the compound orbit, will be inversely, as the cube of the distance of the point from the centre of attraction.

To simplify the expression of the reasoning, suppose that the body is approaching nearer to the centre of attraction. It is evident, that the approach made in the same time will be the same in both orbits, since the mere revolution of an orbit cannot affect the distance of any point in it from the centre. The rate of approach being the same, but the angular velocity being different, it is evident, that the centripetal force must be different; less, for instance, where the angular velocity is greater. The approach made at any point in an instant in either orbit will be the excess of the centripetal force above what would be necessary to retain the body in a circle moving with the same angular velocity; hence the excess in the one orbit will be equal to the excess in the other. Let $a$, $b$ denote the centripetal forces in the compound and simple orbit; $c$, $d$ those in the circles described with the same angular velocities. It appears that $a-c = b-d$, hence transposing $a-c = b-d$; but in each orbit the centripetal force necessary to describe a circle with the same angular velocity is inversely as the cube of the distance from the centre (Prop. XVIII) and therefore the difference of centripetal forces necessary to do the same must also be inversely as the cube of the distance. Hence, at any point the difference of centripetal forces, employed in describing the orbits themselves, will be inversely, as the cube of the distance.

**Prop. XVII.**

If there be two free bodies, the one cannot remain at rest, while, by its attraction, it causes the other to move round it; but if the two bodies receive equal impulses in opposite parallel directions, their centre of gravity will remain at rest, and they will describe similar curves.

The first part of the proposition is manifest from the third law of motion, for as the one body attracts the other, the other will attract the first, and cause it to approach.

The second part will appear thus: Let $A$ and $B$ be the two bodies, $C$ their centre of gravity. It follows, (see Gravity,) that $AC$; $CB$; the mass of $B$; the mass of $A$, or shortly $B$; $A$. Let the bodies receive equal and parallel impulses in the directions $BF$ and $AG$, and suppose that (leaving out the attraction) the body $A$ would move along $AG$ in a moment; join $GC$, and produce it to $F$; $BF$ will be the line past over by $B$ in the same moment; for the impulses being equal, the velocities will be inversely as the masses, that is, directly as $AC$; $BC$, but by similar triangles $AG$; $BF$; $AC$: $BC$. Again, suppose that, in consequence of the mutual attraction, the bodies, in the moment alluded to, describe the curves $BD$, $AE$, then $GE$, $FD$ will be the momentary deflections.

The attractions being equal, $GE$ will be to $FD$: $B$; $A$, that is, $AC$; $CB$; $GC$; $CF$; and hence the remainder $EC$ will be to the remainder $CD$ also in the same proportion, viz. $B$; $A$. Hence the same point $C$ will still be the centre of gravity of the two bodies when they have arrived at $E$ and $D$, and hence it will be so continually.

Again, it is clear that the small arches $AE$ and $BD$ are similar, since all the straight lines connected with the one are proportional to the corresponding lines connected with the other. The arches described the next moment will be similar, for a like reason; and hence the whole arches described in equal finite times will be similar.

**Prop. XVIII.**

The same supposition being made as in last proposition, the curves described will be similar to the curve which one of the bodies would appear to describe to a spectator situated on the other, and conceiving himself at rest.

Suppose the spectator at $A$; Suppose that the Fig. 14. arches $AE$ and $BD$ are described in a moment, and may therefore be considered as straight lines. By the principles of apparent motion, the body $B$ will appear to move in the direction $BD$ with a vel. as the sum of the two velocities, viz. $BD$, $AE$. Hence, producing
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Application. BD to H, making DH = AE, BH will be the apparent motion of B. Join AH; it is parallel to CD, because HD is ≡, and || AE. Hence the Δ AHB is similar to the Δ CDB or ACE. In the same manner, the small Δ, apparently described, and that actually described the next moment, will be similar; therefore the curves apparently described, and those actually described in any finite time, will be similar.

Prop. XIX.

The same supposition being made as in the two last propositions, the times in which the bodies describe their curves, will be to the time in which one of the bodies would describe a similar curve around the other restrained from moving, as the square root of the mass of the other body to the square root of the sum of the masses.

Suppose that the similar arches described, BD, BH, are infinitely small; let BG be a tangent, then FD and GH will be the small deflections caused by the same force in the two curves. Now, when a force of pressure remains the same, the time is proportional to the square root of the space. Hence \( \sqrt{GH} : \sqrt{FD} : \sqrt{HD} : \sqrt{GH} : \sqrt{GD} : \sqrt{AB} \); that is, \( \sqrt{A} : \sqrt{A+B} \).

Hence time in BD : time in BH :: \( \sqrt{A} : \sqrt{A+B} \).

The same ratio will hold with regard to the next two applications.

Cor. The bodies will describe areas proportional to the times around the centre of gravity. For by the proposition, the times of describing similar sectors are in a constant ratio; and it is easy to see that similar sectors are in a constant ratio. But in the large figure, the sectors described are proportional to the times, (Prop. 1.) therefore this must hold also in the small figures.

Supposing the body to have bulk, it can be shown that a force passing through its centre of inertia or of gravity will produce the same effect as if the whole mass were collected in that point, and that in any other direction it will produce two motions, the one rotatory, and the other progressive: See Rotation. The discussion of Central Forces, given above, exhibits some of the chief cases of the action of bodies on one another at a distance. The article Astronomy Physical exhibits others. The action of bodies on one another in contact will be given under Impulse; and their action on one another through the medium of a third, will be seen under Mechanics.

On Dynamics, the reader may consult La Grange's Mechanique Analytique; D'Alembert's Dynamique; Gregory's Mechanics. (T. B.)

DY N

DYNAMOMETER, from dynamus strength, and μέτρησις a measure, is the name of an instrument for measuring the relative strength of men and animals.

The dynamometer invented by Mr George Grahame, and improved by Dr Desaguliers, consists of a strong frame of wood, ABCD. Through the piece DC is a hole D, sufficiently large to admit a cylindrical iron rod, about an inch in diameter. Upon this bar is a square to receive the two separate and unequal arms of a bent lever DE, DE, which are kept tight in their place by a strong screw nut d. The arm DE, which carries a weight W, is prevented from falling below a horizontal position, by a metallic pin at K, which stops the arm DF in its progress towards C, but both the arms move freely in the opposite direction. At the top of the arm DF, seen separately at df, is a round cross bar about six inches long. The iron piece LN, also seen separately, has likewise a cross bar at top, and holes for iron pins to fasten it in its place. Another piece of iron HGI, seen separately at hgi, is fastened to the timber that carries the lever by a strong wooden screw at I, and by the pin k going through its wings and the timber. The collar S is to be put on when the upright arm of the lever is not used, and M is the centre of gravity of the steel-yard DE.

In using this machine, the person who wishes to try his strength, must take hold with his left hand of the round part of the cross at N, and of the round part of the cross at F with his right hand, and then by bringing his right hand towards the left, in the direction FN, he will move DE, and elevate the weight W. When this weight is lifted up so as to make the arm ED just quit the pin at K, the force of the arm will be determined in the following manner: Suppose the weight W to be 56 pounds, and the distance from the fulcrum, viz. WD, fifteen inches, then the momentum of W will be \( 56 \times 15 = 840 \). Let us suppose also, that it requires six pounds applied at M, the centre of gravity of the steel-yard, to balance the steel-yard itself. Then if MD = 10, we shall have \( 6 \times 10 = 60 \) for the additional resistance made to the force of the arm; so that the whole resistance will be \( 840 + 60 = 900 \), which divided by \( FD = 10 \) inches, the distance of the power, will give ninety pounds for the force of the man's arms when applied at F and N. If another man is capable of raising double the weight W, added to double the weight of the steel-yard at M, he will be twice as strong. Instead of increasing the weight at W, the weight may be removed towards E. Desaguliers has described several variations in the construction of this machine, and has given a drawing and description of an instrument for measuring the strength of the fingers; but for an account of these, we must refer the reader to his Course of Experimental Philosophy, vol. i. p. 291, 292. Annot. on Sect. iv.

The dynamometer invented by Leroy of the Academy of Sciences, consisted of a metal tube, ten or twelve inches long, placed vertically on a stand, and containing a spiral spring, having above it a graduated shank terminating in a globe. This shank, together with the spring, was pressed into the tube in proportion to the force which was applied to it, and pointed out upon the graduated shank the strength of the person who exerted the force.

Regnier's dynamometer, however, is that which was invented by Regnier, and of which we have given a representation in Plate CXXLI. This instrument, which resembles a common graphometer in its form and size, consists of a spring AA twelve inches long, and bent into the form of an ellip.
The places are Myriogrammes.

Fig. 2.

A piece of steel B, Fig. 3, is firmly fastened to the spring by means of a claw and screws, and is intended to support a semicircular plate of brass C, Fig. 2, for receiving the scales or graduated arcs. The outermost of these arcs is divided into myriogrammes, and the other into kilogrammes. Each of these arcs is still further subdivided by points, which express the weight in pounds marce; and the various parts of the scale are determined experimentally, by appending accurate weights to one of the extremities of the elliptical spring. On the other branch of the spring, is a small steel support D, furnished with a horizontal cleft at its upper extremity, to receive freely a small copper lever E, which is kept in its place by a steel pin a. This part of the machine is represented on an enlarged scale in Fig. 4.

In the centre of the semicircular plate C, (Fig. 2), a light steel index F is fixed upon its axis by a screw, and has a double point, viz. at m and n, for indicating the divisions on both scales. A small piece of leather, or cloth, is glued upon the lower side of the circular part C, to render uniform, and diminish the friction on the plate. The point m of the index, and the scale of myriogrammes is employed in all experiments, in which the spring is to be pulled in the direction of its greater axis AA, and the point n and the scale of kilogrammes is used, when it is to be employed for experiments in which the two sides of the spring are to be compressed.

The mechanism now described is covered with a small plate of brass CD, Fig. 5, to prevent it from being injured. Upon this plate is a divided arc, corresponding with the first arc of the machine, and by the play of a small index b (Fig. 4) under the plate, the movements of the spring may be ascertained. Through the aperture K, a small turn screw is introduced, for the purpose of relieving or tightening the index, when necessary.

A pallet of brass L, Fig. 3, has a screw, with a cap like that on the needle in the mariner's compass, in which the lower pivot of the lever that pushes round the index is made to play. This pallet, acting like a spring, yields to any sudden concussion, and prevents the mechanism from being deranged. M (Fig. 5) is a socket rivetted on the plate CD, in which the upper pivot of the lever turns. N, N, N, are small cylindrical pillars, to which the plate CD is fixed by three screws.

When it is intended to try the strength of the human body, it is necessary to have an iron rack, Fig. 6, on the lower part of which the feet of the person must rest; and also a double handle of wood, with an iron hook, Fig. 7, which he must at the same time hold with both his hands.

When the strength of animals is to be determined, it is necessary to have a double iron hook, shewn in Fig. 8, one end of which is to be hooked to the end of the spring, and the other to a rope fixed to a stake, as at c, c, Fig. 9.

The three methods of using the dynamometer, are represented in Fig. 9, 10, and 11.

Fig. 9, represents the method of applying the dynamometer, to ascertain the strength of animals. The animal is yoked to the chains PQ, and the force which it exerts against the fixed obstacle R is shown by the index of the interposed dynamometer T. The pin d, Fig. 4, pushes forward the index, which always remains at the place to which it is brought. M. Regnier made experiments with four excellent horses, and obtained the following results:

<table>
<thead>
<tr>
<th>Myriogrammes.</th>
<th>Force exerted by the first</th>
<th>second</th>
<th>third</th>
<th>fourth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>36</td>
<td>38½</td>
<td>30½</td>
<td>43</td>
</tr>
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</table>

which is equal to 730 pounds marte.

Fig. 10 shows the method of determining the strength of the hands, or the muscular force of the arms. The person lays hold of the two sides of the spring nearest to the centre, so that his arms may be a little stretched and inclined downwards, at an angle almost of 45 degrees. This position is considered by Regnier as the most natural, and as that in which a man can exert his whole force. The index will then point out on the scale of kilogrammes the force which has been exerted. The strength of each hand may be tried separately, and the sum of the two will always be found equal to that of both when exerted together.

Fig. 11, represents the method of measuring the strength of the reins of the human body. The person places his feet on the bottom part of the rack, shewn separately in Fig. 6, after one of the ends of the spring has been placed in one of the hooks of the rack, and the hook of the handle, Fig. 7, put in the other end of the spring. The strength which he exerts in this position is then indicated upon the scale of myriogrammes.

The preceding dynamometer is obviously an instrument of great use; and as it does not weigh more than two pounds and a half, there are few practical purposes to which it may not be conveniently applied. For cases, however, where the load or the resistance is stationary, as in those represented in Fig. 9, 10, and 11, we think that a much simpler and more accurate dynamometer might be constructed in the following manner.

Let ABCD be a vessel containing water, and EF a long cylinder, made of any substance heavier than water, suspended in the fluid by a rope GHI attached to the hook G, and passing over a pulley H. When the upper surface E of the cylinder is on a level with the surface of the water, the weight of the cylinder, or the force which it exerts upon the rope GHI, will be equal to the absolute weight of the cylinder in air, diminished by the weight of a quantity of water of the same magnitude as the cylinder. When a horse or a man pulls at the rope HI, so as to raise the cylinder above the fluid surface, the weight of the cylinder will gradually increase; and if the magnitude and specific gravity of the cylinder are duly adjusted to the description of force which is applied, there will be a particular position of the cylinder, at which its weight will exactly balance the force which is applied at I. The forces which are then in equilibrio, or the force required to be measured, will be equal to the absolute weight of the cylinder diminished by the weight of a quantity of water equal to the magnitude of the immersed part of the cylinder. In this way the force of men and animals, and of particular parts of the human body, may be ascertained with the utmost accuracy and facility; and by fixing a scale upon the cylinder, the measure of the force in cwts. or pounds may be seen by simple inspection. The length of the
DYSART, the name of a royal burgh of Scotland, situated on the north side of the Firth of Forth. About the beginning of the 16th century, when Dysart received its charter, it was one of the most opulent and flourishing towns in Fife; but since that period its trade has undergone several fluctuations.

The harbour, though very much exposed, is susceptible of great improvements. The trade of the town was formerly carried on by means of twenty-four square rigged vessels; but the town has now only eight vessels of the description, and a sloop.

The principal exports of Dysart are salt, coals, ironstone. About 17,100 bushels of salt are annually exported. Nearly 15,000 tons of coal are raised every year, and about 3200 tons of ironstone are exported annually to the Carron works. This ironstone yields commonly 12 cwt. of metal per ton of ore. About 500 looms are employed in the manufacture of checks, of which about 530,000 yards are made annually. A number of hanks were formerly employed in building ships, but this branch of business has recently been laid aside; though, from the promising aspect of public affairs, this and the other manufactures of the burgh are beginning to revive. A greater degree of activity already appears in the harbour, and it is hoped that the revival of the Baltic trade will restore to Dysart its former commercial importance.

At a very short distance from the town is a mineral well, which is supposed to be of the same quality as the Pitcaithley water. It is covered by the sea at high water during spring tides. Population of the town about 1730, and of the parish 5385. See Fifeshire.

DYSENTERY. See Medicine.

DYSODIUM, a genus of plants of the class Syngenesia, and order Polygania Necessaria. See Botany, p. 312.

DYTISCUS. See Entomology.

DYSPHANIA, a genus of plants of the class Polygania, and order Monocæa. See Brown's Prodromus, &c. p. 411; and Botany, p. 348.
E.

La Perouse, however, saw one which was 300 feet long, 10 broad, and 10 high, and capable of holding 200 persons.

Easter Island abounds with monuments and statues, which appear to bear the character of antiquity. The monuments are small pyramidal heaps of stones, the upper stone being whitened with lime water, and are erected near the sea shore. The statues, which are of a gigantic size, are raised on platforms of solid masonry, 35 feet long, 14 feet broad, and from 3 to 12 feet high. They are faced with hewn stones, and are specimens of excellent workmanship. Although no cement is employed, yet the joints are very close, and the stones are morticed into another with great skill. The statues are rudely sculptured out of a volcanic production. The nose and chin are not badly shaped; the ears are out of all proportion, and the bodies have no resemblance to the human form. The largest of these statues is about 14 feet six inches long, seven feet six inches across the shoulders, three feet thick and six feet broad in the belly, and five feet thick at the base.

Only three or four canoes were seen. They were about 19 feet long, and seemed unfit for any distant navigation.

According to Captain Cook, the population did not exceed 400 or 700, about one-third of whom were females. In 1765, La Perouse considered the population as nearly 2000, and saw no marks of their being upon the decline. See Cook's Second Voyage, vol. 1. and La Perouse's Voyage, vol. 2.

EASTER, is the name of a feast of the church held in memory of the resurrection of our Saviour. See Chronology, p. 411.

EASTER ISLAND, is the name of an island in the South Pacific Ocean, situated in West Long. 190° 46' 20", and South Lat. 27° 5' 50". It is supposed, without much reason, to have been visited by Captain Davis, in 1686. It was touched at by Roggewein in 1722, and has since been visited and examined by Captain Cook in 1774, and La Perouse in 1785.

This island is from 30 to 35 miles in circumference; its surface is mountainous and stony, and the hills rise to such a height, that they are visible at the distance of about 8 miles. On the north-east coast of the island, the land is remarkably high; on the south-east, the shore forms an open bay, where Roggewein is supposed to have anchored. On the south are two rocky islands, and, about three miles to the north of the south point, is Cook's Bay, having 80 fathoms of water over a sandy bottom, at the distance of three quarters of a mile from the shore. This bay, however, is very dangerous when westerly winds prevail.

At the southern extremity of the island is the crater of a volcano, of great size, depth, and regularity. It was like the frustum of a cone, whose upper and lower bases appeared more than two miles in circumference, and it was at least 800 feet deep. The marsh at the bottom was surrounded with plantations of bananas and mulberry trees, and contained several pools of fresh water, apparently on a level with the sea.

Although the soil is so exceedingly fertile that three days' labour is sufficient to procure the Indian subsistence for a year, yet only about a tenth part of the island is under cultivation; the rest being covered with a coarse kind of grass, which extends to the tops of the mountains. The cultivated portions are of an oblong form, without any enclosures. The weeds are carefully pulled up, and burned in heaps to fertilize the soil; and the soil is kept cool and moist by large stones that lie loose upon the surface. The principal productions of the island are potatoes, yams, tararoreddy root, gourds, plantain and sugar-canes.

The appearance, dress, language, and manners of the people, has such an affinity to those of the other South Sea islanders, that it would be unnecessary to give any particular account of them in this article. The females offered their favours for presents, and the men assisted in this interchange of commodities. They even dragged along girls of 13 or 14 years of age, with the hope of receiving a part of the reward. Their houses are formed of upright sticks, bent towards each other, and tied at the top; and one of them, seen by Captain Cook, was 60 feet long, nine feet high in the middle, and three or four at each end, its breadth being nearly equal to its height.
being six cubits in length and three in breadth. Daniel
is said by Josephus to have built one of its most mag-
nificent palaces, some of the beams of which were of
silver, and the rest of cedar plated with gold. This
splendid edifice afterwards served as a mausoleum to
the kings of Media; and is affirmed by the last men-
tioned author to have been entire in his time. There
are no traces now remaining of these lofty buildings;
and even the site of this celebrated city has become a
subject of dispute among modern travellers. Sir John
Chardin fixes upon Tanis as the most probable situa-
tion; but, at the same time, admits that no remarkable
ruins are to be seen there; and that the materials of
those, which have been found, are different from those
which the Medes employed in the structure of their
palaces. Others suppose it to be Hamadan; and some
Gasien in the province of Yerrak. Merodach, whom
some suppose to have been Nebuchadnezzar, overthrew
Dejoces, and defied his capital, A. M. 3347; and it
was more fatally pillaged by the army of Alexander,
A. M. 3725. See Ancient Univ. Hist. vol v. p. 4;
Judith, c. i. v. 2, 4; Herodotus, l. i. c. 95; Chardin
Voyage en Perse, vol. i. p. 181; Joseph. Antiq. l. x.;
Quint. Curr. l. v. 8. (q)

ECCLESIASTICAL HISTORY.

There are two aspects in which the church of Christ
presents itself to the notice of impartial history. It
may either be regarded in its connection with the civil
and political establishments existing in the world, or it
may be viewed as a separate and distinct society, reared
upon its own principles, and possessing a character and
features exclusively belonging to it. Ecclesiastical his-
tory therefore respects, either the support which Chris-
tianity has received from the secular power, together
with the benefits or the disadvantages resulting from this
support; or as it respects the internal administration of
the church, its constitution and discipline, its doctrine
and its worship. Under the first of these heads, we
shall be able to trace the rise and the decline of priestly
usurpation, and especially that of the papacy; and un-
der the second, we shall have it in our power to mark
the revolutions of theological opinion, connected as they
have uniformly been with those of philosophy and litera-
ture, during the long period of eighteen centuries.
Under the one or the other of the divisions now men-
tioned, almost every thing interesting or profitable in
ecclesiastical history may be conveniently introduced.
In the following article, therefore, we shall endeavour
to keep these divisions steadily in view.

The period of eighteen centuries, above alluded to,
may be separated into four great portions. The first
extends from the birth of Christ to the reign of Con-
stantine A. D. 325, when Christianity became the re-
ligion of the empire. The second reaches onward
from the time of Constantine to the year 755, when the
supremacy of the Pope was acknowledged, and his tem-
poral domains established. The third portion extends
from the acknowledgment of the Pope's supremacy and
the establishment of his temporal dominion, to the era
of the Reformation, about the year 1580. And the last
portion includes the interval between the era of the re-
formation and the present time.

CHAP. I.

The History of the Church from the Birth of Christ to
the reign of Constantine, A. D. 325, when Christianity
became the Religion of the Empire.

In the 753d year of Rome, and in the reign of Au-
gustus Caesar, Jesus Christ was born. The place of
his nativity was Bethlehem in Judæa, and his reputed
father was Joseph, a carpenter of Galilee. At the time
of his birth, the whole world was at peace. The events
of our Saviour's life, which are recorded in the four
evangelical histories that have come down to us, are
well known to his followers, and it is upon the efficacy
of his vicarious sufferings and propitiatory death, that
all true Christians build their hopes of everlasting hap-
piness. Sometime previous to his ascension into heaven,
the founder of our religion gave a charge to his apostles,
commanding them to preach the doctrine which he had
taught them, and assuring them that they should be
furnished with extraordinary gifts as the evidences of
their commission. The words of the charge, which has
been preserved by the evangelist Matthew, are these,
"Go ye, and teach all nations, baptizing them in the
name of the Father, and of the Son, and of the Holy
Ghost." And another of the inspired writers informs
us, that they were instructed to wait at Jerusalem, till
they should "receive power by miraculous communi-
cation from heaven. In obedience to their Master's in-
junction, we find the apostles remaining in the Jewish
capital, and "when the day of Pentecost was fully
come" they were all assembled in one place. "And
suddenly there came a sound from heaven as of a shis-
ing mighty wind, and it filled all the house where
they were sitting; and there appeared unto them clo-
tened tongues, like as of fire, and it sat upon each of them.
And they were all filled with the Holy Ghost, and did
speak in tongues as the Spirit gave them utterance." In
this way the promise of Jesus was accomplished.
The Holy Ghost was poured forth in mighty strength
upon the apostles. They were furnished with extra-
ordinary powers, and especially with the gift of tongues.
And Saul of Tarsus having seen Jesus after his ascen-
sion, "as one born out of due time," and having been
miraculously called to the apostleship, those first mis-
sionaries of the faith, proceeded in the great work of
turning mankind from darkness to light, from ignorance
and wickedness, to knowledge, to righteousness, and to
peace.

The reception of the new doctrine varied according to
the circumstances in which the apostles were placed.
In general, however, it met with a very great degree
of opposition, and the preachers were frequently re-
duced to the necessity of exercising their functions at
the hazard of their lives.

The Jews, having persecuted our Saviour from the sects among
commencement of his ministry, and having at length the Jews
succeeded in putting him to death, could not be ex-
pected to treat his disciples with greater lenity. At
this time, there were three sects, or descriptions of men,
considered in a religious and political point of view,
among the Hebrew people; and each of these sects
seemed to vie with the others, in marked and zealous
opposition to the Christian cause. However much they
Ecclesiastical History.

differed from one another in the principles which they
professed; they agreed in rejecting the claims of Jesus;
they considered him as a pretender to the character of
the Messiah; and thought it not only innocent, but mor-
ritorious, as well as necessary, to suppress the religion
which he taught.

The sects alluded to were the Pharisees, the Saddu-
cees, and the Essenes. The Pharisees were the Thera-
peutae of Judea; a class of men who lived, or affected
to live, in contemplative retirement, and to take no
part in the concerns of the state. They are not men-
tioned in the sacred books; but from other sources of
information we learn, that they held the doctrine of the
malignity of matter, ascribing all evil passions to the
body, and attempting, by abstinence, silence, and other
varieties of mortification, to purify the soul, and to
prepare it for heaven. While they acknowledged the law
of Moses, they regarded the Pentateuch as a collection
of allegorical and mysterious truths; and of course the
chief labour and difficulty of their theology, was to find
the hidden meaning, the holy and celestial import which
the literal enunciation was supposed to conceal. Of all
the Jewish sects, the Pharisees appear to have made, in
point of fact, the least opposition to the progress of
Christianity. The Sadducees were the unbelievers in
religion. They denied the existence of angels or spir-
its, contending, that man stood at the head of all the
works which God had made; and they rejected the no-
tion of the soul's immortality. Their scepticism, how-
ever, had its limits; for they admitted the books of
Moses, and received them as the communications of
heaven to the great legislator of their nation; but they
refused the other parts of the sacred canon, except in
so far as they contained the civil and political history
of the Hebrew people. Though not remarkable for
their numbers, they were of great consideration in the
state. Their influence in the Sanhedrin was such as
to render it necessary to court their favour. Many of
the sect were rich, many of them learned; and they
enjoyed, almost exclusively, the patronage and pro-
tection of the great. During the course of our Savi-
our's ministry, they proposed to him many insidious
questions, either with a view to confound him by their
skill in argument, or to expose him to the resentment
of the Roman procurator, or to the derision of the
people. And when the apostles of Jesus discoursed to
their hearers of a resurrection and a future judgment,
doctrines so completely opposite to the tenets of the
Sadducees, this powerful sect soon proved themselves
to be the most violent of all the persecutors and op-
pressors of Christianity.

In point of numbers, however, as well as influence over
the public opinion, the Sadducees were constrained to
yield to the Pharisees. This last was by far the most po-
pular of the Jewish sects. Their errors, if not more deep-
ly rooted, were more extensively diffused; they presided
in the schools; they were the chief doctors of the law,
the favourite expositors of the Levitical institute, and in-
terpreters of the prophecies; and, in the estimation of
the multitude, they were the surest guides to a holy life.
If the creed of the Sadducees was wrong, the Pharisees
were ample believers. They received the books of Mo-


was in the power of the Pharisees to alter or to modify
them at pleasure. Hence it was that the precepts in
question were so managed in the application, as to in-
crease the wealth, and support the pretensions, of this
predominating sect. Hence it was that the Pharisees
"devoured widows houses" with impudence, and "bound
heavy burdens upon the poor," which they themselves
would not touch with one of their fingers. And hence
it was that our Saviour, after pronouncing a woe upon
them, declares, that they "had made void the law, that
their traditions," and the precepts connected with it,
or illustrative of its enactments, by their traditions.
The character of the leading persons belonging to this
sect was such, as to excite the highest aversion and
disgust of every enlightened and well-regulated mind.
They were very far from having attained to that pure
and heavenly virtue which the people ascribed to them.
Though most scrupulous and elaborate in the exercises
of piety, they were not devout; with long prayers in
their mouths, they fancied themselves in need of no
spiritual gift; and while they enlarged their phylac-
teries, and paid tithe of mint, and anise, and cum-
in, they neglected the great and necessary duties of
justice, mercy, and truth. They afforded us the most
complete specimens of meditated and consummate hy-
pocrisy, and constitute the most perfect examples which
the New Testament exhibits, of all that we are bound
to avoid and to abhor.

The hatred of the Pharisees towards Christ and his
apostles, was marked by its extraordinary virulence.
From some incorrect interpretations of the prophecies
they had figured to themselves the Messiah as a mighty
deliverer, who was to rescue the Israelitish nation
from the oppression of the Roman yoke, and subject the whole
world to the institutions and the authority of Moses.
Our Saviour was not the deliverer whom they expected;
he appeared without the pomp and splendour of royal-
ity; without armies or attendants; and he declared, in
the plainest manner, that his kingdom was not of this
world. The pride of the nation was offended, and the
opposition of the Pharisees was roused in all its bitter-
ness and malignity. After repeated and fruitless at-
tempts to involve Jesus in some charge which might
affect his life, they succeeded in gaining over one of
his immediate followers, and by the well-known trenched
of Judas Iscariot, he was given up to their fury.
It was the impetuous zeal of the Pharisees that urged
the Roman procurator to put our Saviour to death. It
was the Pharisees who sealed the stone which covered
the mouth of the sepulchre; and it was the same ac-
tive and persevering party that bribed the soldiers who
watched the grave, and instructed them to publish the
false account of the resurrection. They were the chief
agents in the martyrdom of Stephen. They granted to Saul the commission which authorized him to bring
the Christians of every description bound to Jerusalem.
And by their ill-supported expositions of the sacred
books, and the delusive hopes with which they flatter-
ed and amused the people, they urged on the destiny,
and precipitated the destruction of their country. Grain-
ing under the severities of a foreign administration, ser-
verities reviled by the face of the Roman governor and
an impatient spirit of the Jews, this unhappy people
at length broke out into open rebellion; and still
dreaming that the era of deliverance was at hand, they
rashly and foolishly set the Roman power at defiance.
The war raged throughout Asia Minor and a great part
of the East. The armies of the empire, under the or-
ders of Titus, marched into the sacred territory. The
chief city of the Jews was besieged, and for six long
months its devoted inhabitants were subjected to all that extremity of suffering with which offended heaven is wont to chastise the aggravated disobedience of man. The Romans assailed them from without, while famine and discord, with the delusions of hope, and the determination of despair, destroyed them within the walls. At length, in the 70th year of the Christian era, Jerusalem was taken by storm, and its temple reduced to ashes. And the prophecy of Jesus was literally accomplished, that of this lofty and splendid edifice, the pride of Palestine, not one stone should be left upon another which should not be thrown down. Eleven thousand of the Jews perished in the siege and in the assault; an incredible multitude of them were carried away to be sold as slaves; and the markets became at last so glutted, that no purchasers were to be found. The altar of God was thrown from its place, and broken in pieces; the sacrifice and the oblation ceased, and the smoking ruins proclaimed "that the glory was departed." Amidst these calamities, the followers of Jesus, who had increased to a considerable number under the ministry of Peter and John, availed themselves of a favourable opportunity; and in compliance with our Saviour's instructions, withdrew from the city and the horrors of the siege. They retired to Pella, a small town beyond the river Jordan, and continued for a while united among themselves, and undisturbed in the exercise of their religion.

Among the Gentiles, the progress of Christianity was distinguished at once by its extraordinary rapidity, and the apparent inadequacy of the means employed to publish it. In an article of this kind, it is impossible to shew at any great length in what respects the different systems of philosophy which prevailed in the ancient world, were at variance with the doctrines and precepts of our religion. But there is one observation which we feel ourselves constrained to make, and it is this: that whatever might be the philosophical systems of antiquity, and however wide the distinctions which separated them from one another, the patrons of all those systems, the masters of all the schools, agreed in supporting, with the whole weight of their authority, and the whole effect of their example, the religion acknowledged by the state. Whether with the Epicureans, a refined atheism was maintained, and pleasure was courted for its own sake, or whether with the Stoics it was believed that happiness consisted in a repulsive and untractable virtue; whether truth was supposed to be attainable by human endeavours, or all was pronounced to be uncertain, fluctuating, and momentary,—it was universally held to be the part of a wise and patriotic man, to comply with the religion established in the country to which we belong. Even Socrates, who seems to have expressed himself more openly than others with regard to the Paganism of his time, is known to have sacrificed a cock to Asclepius, a very short time previous to his death. Indeed it appears to have been an opinion by no means uncommon among the different sects of philosophers, that all the forms of religion were equally useful in governing the people, and equally destitute of a foundation in truth. To interfere with the acknowledged religion, therefore, was regarded not only as unnecessary, but as imprudent and pernicious; and he who should attempt to overturn it altogether, and to substitute another religion in its place, was represented as an innovator, whom it was incumbent on the magistrate to resist and to punish. The opinion, as we have mentioned, was general; and the practical consequence was, that the philosophers of Greece and Rome were sometimes found among the keenest opposers of Christianity, and the most cruel persecutors of its ministers. Besides, there was nothing in the religion of Jesus which was calculated to fill the imagination of the statesman, to excite his ambition, or to reward his activity. It was not associated in the mind with ideas of political glory, or recommended by any connections, real or imaginary, with military success. The founder of the new system belonged to a hated nation, and he had suffered a public and a disgraceful death: the apostles and evangelists were poor men; they could make no promises of wealth or distinction; they had no rewards to allure the covetous, and no honours to bestow on the vain. "Silver and gold have I none," says St Peter to the cripple whom he was about to cure, "but such as I have I give to thee.—In the name of Jesus Christ of Nazareth, rise up and walk."

The case was very different with the popular superstition. The prosperity of the state was intimately associated with its religious institutions, and the glory of its military commanders with that of the gods under whose auspices they had fought. Among the Romans, in particular, the same individual was at once the progenitor of the nation, and an object of their religious worship. The standard under which this victorious people had subdued the world was the bird sacrificed to Jupiter; the capitol, the great object of their reverence, and the sight of which never failed to awaken and to elevate their patriotism, was consecrated to the same divinity; the national history was filled with instances of oracular warning, or of protecting care; and, in one word, all that could engage the attention, and rivet the attachment, of the politician or the citizen, was identified with the existence and the honour of the gods. Nor was this the whole matter. The Pagan superstition had its intrinsic and peculiar attractions. Many of its observances were such as recommended themselves, in the strongest manner, to the most powerful tendencies and passions of our nature. In the worship of Venus, prostitution was an acknowledged part; the festivals of Bacchus were scenes of intoxication and riot; and the very father of gods and men himself, to whom there was none equal or second in authority or in place, was, in many particulars of his history, a notable example of cruelty and debauchery. Religion is the imitation of the gods which are worshipped. The people were not reluctant or slow to comply. A system which allowed of such indulgencies, and afforded such examples, was not likely to be speedily abandoned. It had enlisted the ruling passions on its side; it had fixed its dominion in the heart, and there seemed to be no power on earth which was equal to the task of driving it from its place. It was the ancient religion, it was sanctioned by the learned and the wise, it was patronised by the rich and supported by the great, it was closely associated in the minds of men with the national glory, and it had captivated and enslaved the people by its splendid rites and licentious indulgences. What, then, must have been the opposition which Christianity was doomed to encounter! And how great must have been the labours and the patience of those who were commissioned to preach its doctrine, and to establish it in the world!

The labours and the patience of the apostles were, Miraculous undoubtedly very great; but it is not to these alone gifts, that we must ascribe the rapid progress of Christianity. While we give all credit to the early teachers of our religion for their unextinguishable zeal and unwearied activity, we must not forget that their apparent means
were few in number, and limited in their operation. They had no arms in their hands, like Mahomet and his warlike followers; it was not at the head of a devoted soldiery that they preached the gospel; they were utterly destitute of wealth or influence; and, except in the case of the apostle Paul, they had no pretensions to learning. The current of popular opinion and of popular feeling ran strongly against them; and they knew very well, that they were "hated of all men" on account of the religion which they professed. It is to other and higher causes, to a mightier machinery, and to a power more than human, that we must ascribe the extraordinary rapidity with which Christianity was propagated. The apostles and evangelists were endowed with miraculous gifts: they healed the sick, they cleansed the lepers, they restored the dead to life. And what fitted them, in a remarkable degree, for the important work which they had undertaken, they spoke to every nation which they visited in its own language, proclaiming the glad tidings of reconciliation and of peace, and supporting and comforting their disciples amidst the sufferings to which they were exposed. "There was in their very words," says a respectable writer, "an incredible energy, an amazing power of sending light into the understanding, and conviction into the heart. To this were added the commanding influence of stupendous miracles, the foretelling of future events, the power of discerning the secret thoughts and intentions of the heart, a magnanimity superior to all difficulties, a contempt of riches and honours, a serene tranquillity in the face of death, and an invincible patience under torments still more dreadful than death itself; and all this accompanied with lives free from every stain, and adorned by the constant practice of the sublime virtue." They were enabled likewise to communicate the same extraordinary powers to others, of which they themselves possessed. The evidences of their commission were multiplied on every side; the temples of idolatry began speedily to be forsaken, the number of ages was broken and dissipated, the eye was filled with the prospect of immortality, and the world, awakened and active, pressed forward to everlasting life. Churches were quickly established in almost every portion of the Roman empire; in Phrygia and Galatia, provinces of Asia Minor, and in Ethiopia; at Corinth, at Philippi, at Thessalonica, and in the capital itself. In a short time, nations and cities more remote, heard of Jesus and of his doctrine. The Gauls received the knowledge of Christianity from the immediate successors of the apostles; and during the course of the second century, the Germans, the Spaniards, and the Britons, were added to the multitudes in other places, who made open profession of the Christian faith.

Fortunately for the cause of Jesus, and the best interests of mankind, our holy religion had acquired a considerable degree of stability before any laws were enacted against it. The Christians were at first almost universally regarded as a sect of the Jews, and they escaped from persecution under the general toleration which had been extended to the Hebrew people. The distinction, however, between Christianity and Judaism, came in time to be known. The followers of Jesus made such open and zealous attacks upon the Paganism with which they were surrounded, that the populace considered them as atheists; and this opinion, most incorrect and injurious in itself, having been once entertained, speedily gained strength and currency, because it was perceived that the Christians had no temples, altars, or sacrifices. They held likewise their meetings in secret; they often assembled in the night; and it was sagaciously inferred that they withdrew from the public eye, in order to practise some abominable rites, which they were afraid or ashamed to disclose.

In these circumstances, the Emperor Nero set fire to the city of Rome, and reduced a great part of it to ashes. This wanton act excited the indignation of the people. The emperor, anxious, as it seems, for his popularity, laid the guilt, and all the odium connected with it, to the charge of the Christians. He commenced a very severe persecution against them. He inflicted upon them the most cruel punishments. Some of them were crucified, others were impaled, some were thrown to the wild beasts; and not a few, having been wrapped in clothes smeared with pitch and sulphur, were burnt during the night, and made to serve as torches for illuminating the gardens of the emperor. In the meantime, this prodigy of inhumanity, entertained the people with Circensian games, and was himself an unblushing spectator of the whole; sometimes walking about in the dress of a charioteer, and mingling with the crowd, and at other times viewing the exhibitions from his car. But all his attempts were without effect; neither his largesses, nor his concern for the honour of the gods, nor his merciless severity towards the unhappy followers of Christ, were sufficient to remove from him the imputation of having given orders to set the city on fire. And accordingly he has been transmitted to us, by the pen of Tacitus, in the double character of an incendiary and a persecutor; and his very name is proverbial for all that is tyrannical, cruel, and brutal, and for all that is malignant, perfidious, and mean. After this persecution, which took place about the year 64, and during which St Paul was beheaded at Rome, the churches had rest for a time. Under many of the succeeding emperors, however, they were exposed to the resentment of their enemies. In the reign of Domitian, the apostle John was banished to the island of Patmos, where he wrote his Apocalypse. And a countless multitude of individuals, whose names no history records, and who have long ago passed away out of the memory of man, boldly avowed their attachment to the faith "once delivered to the saints," and rejoiced that they were counted worthy to suffer or to die in the cause of Christianity.

Even the Emperor Trajan, who has been described as a mild and accomplished prince, is to be numbered among the persecutors of the church; and mild and accomplished as he undoubtedly was, when compared with his predecessors, he appears to have meditated nothing less than the extinction of the Christian name. There has come down to us a correspondence between this emperor and the younger Pliny, who was governor of Bithynia, and it refers to the very subject which now occupies our attention. The correspondence in question is deserving of particular notice, both because it shows us how the Christians were treated in those modes of investigation to which the name of trial has been given, and because it affords us the testimony of a Roman magistrate, to the purity and simplicity of their manners. After expressing to the emperor his doubts with regard to the plan of conduct which he ought to follow the procurator of Bithynia, the enlightened and philosophic Pliny, thus declares what he had already done; (Pliny's Epistles, vol. x. p. 97, 98.) "In the mean time," says he, "this has been my method with respect to those who were brought before me as Christians... I
asked them if they were Christians: if they pleaded guilty, I interrogated them twice afresh, with a menace of capital punishment. In case of obstinate perseverance, I ordered them to be executed. For of this I had no doubt, whatever was the nature of their religion, that a sullen and inflexible obstinacy called for the vengeance of the magistrate.

Strange conduct this for a judge, and a very extraordinary mode of trial indeed! Yet such was the treatment of the Christians at the tribunal of the younger Pliny; a man whose character for benevolence, and even for justice, is perhaps the most unexceptionable of any which pagan antiquity can furnish. The testimony, however, given by the same distinguished person to the simplicity and purity of the Christian manner, must not be hastily passed over.

"And this," says he, "was their account of the religion which they professed, whether it deserves the appellation of a crime or an error, namely, that on a stated day, they were accustomed to assemble before sunrise, and to repeat among themselves a hymn to Christ in the character of a God, (Christo quasi Deo,) and to bind themselves, by an oath, not to commit any wickedness, but, on the contrary, to abstain from thefts, robberies, and adulteries; not to violate their promise or deny a pledge: after which," continues the judge, "it is their custom to separate, and then to meet again, sitting down to a harmless meal, of which all are invited to partake."

We are proud of this testimony: it comes from one who evidently believed the statement to be correct; it comes from a man of education and discernment, and it is to be found in a confidential letter from this man to the emperor, acknowledging his incompetence, and begging to be informed how he should act in so peculiar a case. And it puts to flight, for ever, all the accusations which interest and malice have brought against the tendency of the Christian doctrine, and the purity of the Christian assemblies. The persecution, however, with some restrictions, went on. "The Christians," says the emperor in his reply, "are not to be sought for; but if any are brought before you, and convicted, they are to be punished.

Indeed the human mind revolts at the sufferings which the followers of Christ were doomed in many places to experience. They were publicly whipped till their bones and sinews appeared; their flesh was torn from them with pincers; they were consumed in a slow fire, carefully prevented from reaching the vital parts; they were tortured in iron chairs, made red hot, and kept glowing to receive them. The aged and venerable Polycarp was put to death; the excellent and learned Justin obtained the crown of martyrdom. In the beginning of the third century, Irenæus, bishop of Lyons, sealed his testimony with his blood. Pantamiæna, a woman of great beauty, was condemned to suffer on account of her religion, and, with Marcella her mother, was burnt to death, melted pitch having been poured over their naked bodies. The time would fail us should we attempt to enumerate the victims of superstition. Neither age nor sex was spared. The arm of power was lifted up; the genius of man was exhausted in the invention of tortures; and, to a hasty observer, it might seem, that the hour was at length come when Christianity, subdued and worn out with sufferings, would resign her name and her place among men.

This conclusion, however, would be the very reverse of the truth. The Christians had multiplied in a most extraordinary degree. They filled the senate-house and the army, and they were to be found in all situations and employments. Persecution had produced upon them its usual effects,—it had not only united them more closely together, but it had inflamed their zeal and quickened their activity. Their opinions soon became general; a very great majority of the people embraced and avowed them, till at length, in the year 325, Constantine the Great was invested with the purple, and the government of Jesus became the religion of the empire. From this time Christianity was not only tolerated, but protected and cherished. The number of the edifices consecrated to the worship of God was increased, and the emperor himself was not ashamed to be seen engaging in the exercises of religion, or in the devout observance of the ceremonies ordained by the church. It has been said, that when Constantine was about to engage in battle with his rival Maxentius, he saw in the heavens a luminous cross, with the following inscription, "by this overcome," and that in consequence of the vision and the success which attended his arms, he embraced Christianity. We are aware that the story has been suspected, and perhaps not without reason; but whatever truth or falsehood there may be in it, we have no hesitation in ranking the Emperor Constantine among the sincere professors of the Christian faith.

The doctrine of the primitive church is to be learnt with the utmost certainty from the books of the New Testament. These books were received by the leading men in the Christian assemblies, and approved of by the people at large; they were publicly read, and carefully preserved and transmitted; and having been collected into a volume, towards the end of the first century, they became, to all the followers of Jesus throughout the world, the only standard of faith, and the only rule of righteous conduct. The primitive church believed that there is one God, uncreated and everlasting: that the Logos, or word of God, "who was in the beginning with God, and was God," became "bone of our bone and flesh of our flesh," and dwelt upon this earth: that he gave himself for us, "an offering and a sacrifice," and that, "being justified by faith in him, we have peace with God." That our present state is a state of condemnation, corruption, and suffering: that, by the transgression of our first parent, we are enetered into the world, and death by sin; and that "death hath passed upon all men, for that all have sinned." That the soul of man shall exist in a future and unchangeable state of happiness or misery: that, by the influence of the Holy Ghost, our understandings are enlightened in all heavenly knowledge, and our hearts changed from all evil dispositions: that Jesus Christ, having risen from the dead, will appear in the end of all things as the judge of the whole world; and that in the great day of trial and of retribution, he will receive his followers into "mansions" of happiness, where they shall abide forever, beholding his glory, the glory which he had with the Father, before the world was." Such is the sum of the doctrine maintained by the early churches; and it is this doctrine alone which they agreed in considering as "the faith once delivered to the saints."

From the doctrine of the primitive church, we are naturally led to the consideration of the heresies with which it was infested. Some of these heresies appear to have arisen very soon after the first promulgation of Christianity; nor is our religion, even at this moment, and in the countries where it is professed, in its greatest purity, entirely free from their influence. Most of the heresies in question derived their origin from the union of philosophical speculation, or what was called philosophical speculation, with the doctrine of the sacred books. This was particularly the case with the
Heresy of the Gnostics.

The history of the Gnostics, a heresy which must be considered as the fruitful parent of many others, we have almost said of every error which has corrupted and disfigured the simplicity of the primitive faith. At the bottom of this predominating heresy, lay the eastern dogma of the two principles, the one the source of good and the other the source of evil. To the good principle, the Gnostics gave the titles of the Supreme Divinity and the Everlasting Father; while they considered matter as the evil principle, and represented it as independent and active, the antagonist, and, in some instances, the successful rival of the beneficent power. To the evil principle, they attributed the creation of the earth, and the disposition or arrangement of the habitable globe. They held, too, that the soul, which, according to their idea of it, was naturally ethereal and pure, was clogged and depressed by the material body, that its inherent energies were restrained, and its progress towards heavenly happiness obstructed. They contended, that a great Messenger and Deliverer was expected from above, who was to put an end to all such restraints and obstructions, to emancipate the imprisoned and shackled spirit, and to relieve the whole intellectual world from the dominion of matter. They believed in Jesus Christ as the messenger and deliverer, by whom those mighty revolutions were to be accomplished. They spoke of him as the Son of the Supreme Divinity, and, consequently, possessed and dispatched from the habitations of the Everlasting Father. They regarded him as a created existence; and maintained, that though to the eye of man he appeared to be invested with a real body, and exposed to actual pains and privations, he was, in point of fact, destitute of all corporeal organs, and incapable of suffering. In a perfect consistency with their own opinions, they denied the resurrection of Christ, and that of the body in general. They believed, moreover, in a great pléonome, or space above the visible heavens; and this pléonome they sometimes represented as the immediate residence of the benevolent divinity, and at other times as filled with inferior existences, called genii. To the higher genii were added the genii, whose abode was chiefly upon the earth, and whose business and delight it was to thwart the purposes, and disturb the enjoyments of the human race. And in addition to all these jarring particulars, they denied the authority of the Jewish scriptures, and, with an unaccountable and repulsive absurdity, held the serpent in high estimation as the author of sin.

From the motley and incoherent system which we have now attempted to describe, certain practical consequences arose. First of all, it led the Gnostics to the incessant study of magic, in order to avert the influence, or weaken the power of the malignant genii. And, secondly, they were taught by it to practise all the varieties of mortification and modes of austerity. The body was the source and centre of evil, and it was not to be supported or cherished, lest the soul, the ethereal part, should be still further degraded and enslaved. Hence the more rigid of the sect abstained from the most innocent gratifications; they rejected marriage and the society of women, and spent their whole lives in a complete abstraction from the world, in penitence, obnubilance, and prayer. Who does not see that the celibacy of the Romish clergy, and the penances which the Romish church enjoins upon her votaries, may be traced to the heresy of the Gnostics, and especially to that part of it which respects the malignity of matter? Monastic institutions had their origin in the same error. Simon Stylites must be regarded as a practical disciple of the Gnostic school. St Dunstan, if there be any truth in the history which is given of him, may be classed with Simon Stylites; and the race of pilgrims and flagellants will complete the catalogue of deluded individuals, and the triumph of philosophical speculation over the simplicity of genuine Christianity, and the obvious application of its precepts. What we have stated above was the practice of the more numerous and rigid of the Gnostics; others of them, however, made a different use of their favourite notion, the malignity of matter; for they regarded the soul as utterly unaffected by the actions of the body, asserted the innocence and the propriety of yielding to every dictate of nature, and indulged themselves in every species of vice. This division of the Gnostics could not possibly have any great respect for the decalogue or the authority of Moses; and we may not perhaps be very far mistaken, if we suppose them to have been the chief admirers of the serpent.

The tenets of the later Platonists were scarcely less pernicious than the reveries of the Gnostics. Besides their philosophical opinions, which were those of the Eclectics, they maintained that the morality of the sacred scriptures was of two sorts, one more gross, for the multitude, and another more refined, for Christians of superior merit and sanctity. Hence the counsels of our religion were distinguished from its precepts; the former being meant for those who, by contemplative abstraction, aspired to an immediate intercourse with the Divinity, and the latter for such as were disposed to satisfy themselves with discharging the ordinary duties of life. They maintained likewise the pernicious dogma, that the end, if good, justifies the means which are employed in order to attain it, of whatever description those means may be. It is true, this sentiment was propagated at first with great caution, and with many explanations; but it soon spread abroad, and was generally received, and it gave birth to all that train of imposture, and all those pretended miracles and legends, which, in succeeding ages, brought disgrace upon the Christian church. Alexandria was the chief seat of the later Platonists. Ammonius Saccus is regarded as the founder of the sect; and it ranks among its adherents no less a man than the respectable Origen himself.

For an account of the primitive order and government of the church, the reader may consult the History of the following period, where the rise and progress of the papacy is traced.


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CHAP. II.

The History of the Christian Church from the time of Constantine, A.D. 325, to the Year 755, when the supremacy of the Pope was acknowledged, and his temporal Dominion established.

The order established and recognized in the primitive church, was exceedingly simple. The care of each congregation was entrusted to its pastor or bishop, along with a certain number of assistants; and these last were particularly consulted in matters of government and discipline. To the pastor or bishop, and his assistants, were added the deacons, whose business it was to take charge of the poor. The office of pastor continued for life, unless it was forfeited by some instance of misconduct on the part of him who enjoyed it. He was commonly styled the bishop or overseer, and sometimes the angel of the congregation to which he belonged: (See Bishop.) In the first age, the ecclesiastical functions were supported by the voluntary contributions of the
people attached to them. The whole society was joined together in one principle of love, and its members were distinguished by a "simplicity and godly sincerity," which we shall look for in succeeding ages of the church.

Out of this primitive simplicity, the hierarchy and the papacy arose; but they arose by gradual steps, and consecutive and sometimes imperceptible deviations, from the apostolical pattern. *Nemo fit repepte irrisimus,* is a maxim which applies not only to individuals, but to societies. "The interest and the splendour of an order of men may be promoted and secured by unjustifiable means, as well as the interest and the splendour of any one man. But in both cases, the changes are commonly slow, and the encroachments gradual and successive. Let us trace, as shortly and distinctly as we can, the steps by which the usurpations of the hierarchy reached their unwarrantable and criminal height.

First of all, the distinction between the bishop and his assistants was rendered more obvious and considerable. Next, an idea began to prevail, that these assistants were only the representatives of the bishop, deriving their powers exclusively from him, and subject, in the exercise of those powers, to his superintendence, inspection, and control. He ordained the functionaries in question to the clerical office, and they were tried in what may be called, even at this early period, his consistory court. The property of the church, arising from the liberal donations of the Christian brethren, was now regarded as belonging, in a great degree, to the bishop, and in the disposal and use of it, he not infrequently consulted his own importance and splendour. This property was sometimes in land; but whether in land, or in money, or in cups and vestments, when once consigned to the church, it remained for ever in her possession. She could acquire property, but she could not lose it; no individual could deteriorate it to the injury of his successor; no deed or settlement could alienate it, to the injury of the community.

The next step seems to have been taken by the bishops residing in large towns. In those towns, the ecclesiastical assemblies were usually held; the bishop, always on the spot, and growing daily in wealth and influence, was commonly chosen president of these assemblies. When once chosen, he would not easily be prevailed upon to resign his place. In a short time, he would claim it as his right. Prescription would sanction what usurpation had begun. And thus the bishop, once upon a level with his presbyters, or at most upon a level with his brethren of the episcopate, would be established in precedence and splendour, as the metropolitan of the province to which he belonged. His powers were then extended and confirmed; new claims were made and allowed; the civil polity of Constantine afforded an example; the ecclesiastical constitution was made to approximate to the political; the rulers of the church corresponded to the high officers and governors of the state; their provinces were of similar extent, and though their functions were different, their authority was nearly the same. The metropolitan now became a patriarch, and in process of time the patriarch became a pope.

This change, however, the completion of sacerdotal absolutism, was the result of other circumstances and considerations, besides those which we have mentioned above. It had been observed, that in the enumeration of the apostles, given by the sacred writers, Peter held the first place, probably of his age, and personal respectability. "Now the names of the twelve apostles," says St Matthew, "are these, first, Simon, who is called Peter, επίσκοπος Σίμων ἐκ Παλαιστινῆς;" first Peter, that is, as Dr Campbell seems to think, "Peter, occupying the first place." It had been remarked likewise, that this apostle is represented by Christ himself as the rock on which the church was to be founded. "Thou art Peter," says he to him, "and on this rock, (alluding to the name,) will I build my church," that is, in consequence of his ministry and apostolical labours, shall the religion which I am commissioned to teach, be introduced into the world, and finally established. Accordingly, the apostle Peter was the first who preached to the Jews the doctrine of our Saviour's resurrection as a tenant of the Christian faith; and he was the first also who announced to the Gentiles, that they were admitted into the covenant of Abraham, and entitled to all its privileges and blessings. By the bishop of Rome, however, and his adherents, these passages of holy writ were understood in a very different sense. In their apprehension, St Peter occupied the first place, not on account of his years, and his personal respectability, but solely on account of those powers and dignities which were conferred upon him by Christ. He was the rock, they affirmed, on which the church was built, the foundation and support of the whole. And in their zeal for their own aggrandizement and interest, they forgot the declaration in which we are assured that the church is built on "the apostles and prophets" generally, "Jesus Christ himself being the chief corner-stone."

But it would be of no consequence to invest St Peter with powers and dignities, unless the bishop of Rome could prove himself to be the legitimate successor of that venerable apostle. This, of course, he attempted. It was given out, and very soon believed, that the see of Rome was founded by the apostle alluded to; though it does not appear from any historical document, that he ever visited the capital of the Roman world. There was a prevalent tradition, however, that such had been the case. The claim once made, was not to be abandoned. It was affirmed more loudly than ever, that St Peter, the first and chief of all the apostles, was the founder of the holy see. And it was no less pertinaciously maintained, that the powers originally conferred on this distinguished individual, had descended by regular devotion upon his successors in office. The inference was plain. The bishop of Rome, like St Peter himself, was the rock on which the church was built, the foundation and basis of the whole superstructure, without which it could not stand together for a moment, but must instantly fall into ruins. The powers of the church were invested in him alone, laid up as it were, and condensed in his sacred person. If others were the branches, he was the root; if others might be permitted to call themselves the streams, he was the inexhaustible fountain which supplied the whole. In one word, he was constituted by Jesus Christ himself the supreme legislator and judge of the universal church; and all bishops, metropolitans, and patriarchs, were subject to his authority, and dependent on his sovereign will.

This it must be owned was a sweeping conclusion; the patriarch of Constantinople the rival of the pope. The patriarch of Constantinople in particular was extremely dissatisfied with it. There were other churches, he said, which were founded by the apostle Peter, as well as that of Rome. By the consent of all antiquity, the church of Antioch was one of these. And he insinuated in a way which could not be misunderstood, that as Constantinople was the seat of empire, the place where...
the Master of the world condescended to reside, the bishop of that city was clearly entitled to the first voice in point of authority, and to all precedence in point of rank. He had his claims as well as Rome; his footing was good, and his assurance strong; and so satisfied was he of his right and privilege, and so jealous of his rival, that he was the first who took the title of universal bishop. But whatever might be the claims of the Byzantine church, these claims were not ultimately established. The bishop of the West was at one time too powerful, and at another too cunning, for the Eastern prelate. The Latin churches likewise united more cordially and effectually, in supporting the pretensions of their ecclesiastical head. And at length, Felix the Second, a bold and resolute pontiff, summoned the patriarch of Constantinople before himself, and a synod of his Italian clergy, and after due consultation, solemnly degraded him from his rank, and deposed him from his office. It is true, the Eastern bishop laughed at the impotent attempt of his lofty antagonist, and anathematized him in his turn. But the Byzantine pontiff gradually sunk into the second place; and though his claims were not relinquished, he found it necessary to urge them only at favourable seasons, and with great prudence.

We are not to suppose that, even in the first century, the power of the Christian bishops was limited to matters of doctrinal decision, or of ecclesiastical polity. It comprehended a very great proportion of those questions which now belong exclusively to the jurisdiction of the civil magistrate. There is some countenance given to this extension of the episcopal power in the sacred writings, and especially in the epistles of St Paul; and it was perhaps necessary, in the early and unsettled state of the Christian communities. "If thy brother," says Jesus, (Matth. xviii. 15.) "tresspass against thee, go and tell him his fault between thee and him alone: if he hear thee, thou hast gained thy brother; but if he will not hear thee, then take with thee one or two more, that at the mouth of two or three witnesses every word may be established. And if he neglect to hear them, tell it to the church, but if he neglect to hear the church, let him be to thee as a heathen man and a publican. Verily I say unto you, whatsoever ye shall bind on earth, shall be bound in heaven, and whatsoever ye shall loose on earth shall be loosed in heaven." And in conformity with what has now been quoted, the apostle Paul enquires of the Corinthian Christians, why they went to law "before the unjust, and not before the saints? Is it so," says he, (1 Cor. vi. 5.) "that there is not a wise man among you? No, not one that shall be able to judge between his brethren; but brother goeth to law with brother, and that before the unbelievers. Now therefore there is utterly a fault among you, because ye go to law one with another."

We do not stop to enquire whether these passages were rightly interpreted or not. It is sufficient for our purpose to state, that these and similar passages were long supposed to sanction, in the most authoritative manner, and to the utmost extent, those encroachments on the civil power, which characterize the ambition, and dishonour the annals of the popish church. By a little management, almost every question was made to put on an ecclesiastical aspect, and as such it was tried in the episcopal courts. The parties concerned might indeed belong to the laity, and not to be the clergy; but the Church was regarded as distinct from the parties, was pronounced to be of a different nature. Of justice had been denied by the civil magistrate: and where had the poor man, injured and oppressed as he was declared to be, an opportunity of making his complaint, unless before the rulers of the church, the constituted guardians of innocence, and the delegates of heaven? Or the case was from the beginning of a mixed nature, and belonged in its substance and character to the bishop as well as to the magistrate. Or the feudal officers were too fond of their amusements, too careless, or too illiterate to interfere. From these causes, it grew into a maxim, "that except in places bordering on the infidels, a good lawyer makes a better bishop than a good divine." Enroachment followed encroachment. The clergy, while they exercised their functions as judges, and in civil questions too, proceeded also to legislate. The principles of the canon law gave an aspect and colouring to those of the civil; and the supremacy of the Roman pontiff, in ecclesiastical matters, being acknowledged, the ambition of the papal see appeared to look forward to nothing less than a despotism over the whole Christian world, in all its interests and concerns. In addition to this, the pope was now raised to the dignity of a temporal prince. About the year 755, Pepin king of France, made over to him twenty-two cities of Italy; and in one part of Europe, at least, the successor of the poor and humble Peter reigned uncontrolled in the exercise of the civil as well as the ecclesiastical authority, and united in his own person the highest offices of king and of priest. In a succeeding age he laid claim to infallibility; and in the proclamation of the human understanding, and presumptuous plentitude of apostolical power, he disposed of crowned and governments at his pleasure.

No sooner had Constantine the Great ascended the throne of the Caesars, than his attention was directed to the Arian heresy. This heresy, which long divided and afflicted the church, had many patrons and supporters. It gave rise to many personal disputes, and it broke and disturbed the peace which Christianity might have enjoyed under the imperial protection.

The heresy alluded to was propagated by Arian, a presbyter of the church of Alexandria; He was a man of considerable learning, acuteness, and eloquence, and his natural abilities were sharpened and improved by the opposition which he met with, and the controversies in which he was engaged. He maintained, in the assembly of the Alexandrian presbyters, and against the opinions of his bishop, that in the sacred Trinity, the Son was essentially different from the Father; that there was a time hid in the depths of eternity, when he did not exist; or, in other words, that he was really a creature, produced or brought into being by the supreme volition of the true God. He contended farther, that though a creature thus produced, the Father had impressed upon him the effulgence of his glory, and transmuted into him his ample Spirit;" that he was the former of the world, and that he governed the universe as the representative of the eternal and unchangeable Divinity. In consequence of these tenets, Arius was publicly condemned and excommunicated by Alexander, his bishop. He retired, however, into Palestine, where he was received and protected. The number of his followers increased. The angry passions were awakened, and the controversy was agitated with the utmost violence. Distant provinces and churches engaged in the dispute. The combatants became every day more and more warm: reproach took place of argument; and the sacred scriptures themselves, and even the very subject of the discussion, were forgotten amidst personal quarrels and mutual reviling. The contests of the
schoolmen, in the dark ages, may have been violent, but they must have exceeded all common measures of asperity, if they surpassed, in malignant zeal and fierce recrimination, the dispute which now roused and dishonoured the church.

In these circumstances, Constantine, with a laudable concern, but perhaps with little knowledge of human nature, wrote first of all to the bishop of Alexandria, and afterwards to Arians himself, reprimanding them for their indecent hostility, and exhorting them to peace. But it soon appeared, that the paternal advice of the emperor might have been spared. Neither of the parties was willing to yield, because each of them, of course, believed his antagonist in the wrong. The subordinate agents likewise in the dispute, had their victories to gain, their enemies to crush, and their interests to serve: In reality, the letter of the emperor had no other effect than that of magnifying the controversy in the public estimation, and of inducing those, who, from indolence or prudence, had hitherto been silent, to range themselves with the one party or with the other; to resist the heretick or to abandon the church. Something more decisive, therefore, was to be done. Accordingly, the imperial summons was issued, and an ecumenical or general council convoked: And in the year 325, the representatives of the whole Christian world assembled at Nice in Bithynia, to ascertain the Catholic doctrine, and provide for the tranquillity of future generations.

The appearance of the assembly was venerable in the highest degree. No fewer than two thousand ecclesiastics, according to some accounts, had risen from their retirements in obedience to the imperial summons, and of these three hundred and eighteen were bishops. The emperor himself presided in the council, "exceeding," as Eusebius says, "all his attendants in stature, gracefulness, and strength, and dazzling every eye with the splendour of his apparel." And the question to be decided related to nothing less than the peculiar distinctions which may be predicated of the divine essence, and the honour which belongs to the Son of God. Impartiality, however, obliges us to declare, that the conduct and deportment of the fathers did not exactly correspond, either with the respectability of their appearance, or the solemnity of the occasion. They seemed to think, that they had met together, rather with a view to settle their private disputes, than to ascertain the Catholic faith. Numerous complaints were made, and loads of memorials transmitted to the emperor. These memorials were little else than accusations of parties or of individuals, each man libelling his antagonist, and representing him as an enemy to the church. It is said that the emperor, having collected the libels in question, threw the whole of them into the fire; advising the fathers, according to the precept of our Saviour, to forgive one another as they themselves expected to be forgiven, and modestly hinting, (as Sozomen observes,) that it did not belong to him to decide the differences of Christian bishops. Having proceeded so far, he requested the immediate attention of the council to the weighty matter which lay before them. Upon this subject, however, there was a very great and unexpected unanimity. The doctrine of the church appears to have been so completely separated from the heresy of Arius, that no private dissensions, or remaining rancour among the members of the synod, could prevent them from agreeing upon the question at issue. The tenets of the disputatious presbyter, as he was called, were solemnly condemned; and, by the order of the emperor, he was banished into Illyria. The Homousian doctrine, or the doctrine of Consubstantiality, was pronounced to be the faith of the church; and though there were certain differences of opinion with regard to the correct meaning of the term ὑπὸστάσεως, and though it was for some time disputed, whether this term applied to the nature of the Godhead, or to the persons (ὑποστάσεων) in the blessed Trinity, still it was finally declared, with scarcely a dissenting voice, that Jesus Christ, the Son of God, was not, in substance or essence, distinct from the Father. Arians himself was present in this assembly, the most numerous which the Christian world had ever witnessed before. He was supported by Eusebius of Nicomedia, Maris of Chalcedon, and Theognis of Nice. These ecclesiastics, who seem to have been persons of considerable ability, attempted to explain or to qualify the heretical opinions; but Eusebius alone persisted in refusing to subscribe the sentence of the council. Among the orthodox, the chief speaker was the famous Athanasius, then only a deacon in the church of Alexandria.

The following may be considered as a summary of The Nicene council, the second in the order of time, and the Heavenly Trinity, at the period to which our observations refer. It is a version of the Nicene creed, as it appears in the Epistle of Eusebius to the Cæsareans, &c.

"We believe in one God, the Father Almighty, maker of all things, visible and invisible. And in one Lord Jesus Christ, the Son of God, the only begotten; begotten of the Father, that is, of the substance of the Father. God of God, Light of Light, true God of true God; begotten, not made; consubstantial with the Father, by whom all things were made, both things in heaven and things on earth: who, for us men, and for our salvation, came down, and was incarnate, and became man, suffered and rose again the third day, and ascended into the heavens, and comes to judge the quick and the dead: and in the Holy Ghost. And the Catholic and Apostolical church doth anathematize those persons, who say, that there was a time when the Son of God was not; that he was not before he was born; that he was made of nothing, or of another substance or being, or that he is created, changeable, or convertible."

To the Arian controversy succeeded the Pelagian, in which St Augustine distinguished himself; but as the heresy of Pelagius is nearly allied to that of Arminius, we shall afterwards have occasion to treat of it, in giving our account of the Synod of Dort.

Our attention must now be directed to another quarter. About the commencement of the seventh century, a new religion began to spread itself in Arabia; and Christianity received a blow, nearly fatal, from the doctrines and the conquests of Mahomet. In whatever light we view the prophet of Mecca, we cannot hesitate to pronounce him an extraordinary man. Without that learning which is to be derived from books, he was far from being ignorant; of great natural acuteness, he employed that talent in distinguishing between human characters, and in ascertaining the motives by which they are influenced or formed; and prudent and dextrous, he rarely let slip an opportunity of increasing his knowledge, or establishing his reputation. While yet in the service of Cadijah, a rich widow, whom he afterwards married, he travelled into Egypt, Syria, and Palestine; comparing the manners of the people, noting their genius, and marking the defects or the excellencies of the governments under which they lived. Though originally poor, he was born of an illustrious race. His person was beautiful, his forehead large and liberal, and
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In the depths of solitary retirement, and in the cave of Mecca, about three miles from Mecca, the impostor of the East appears to have conceived the first idea of his prophetic mission. His visions were many, and his intercourse with heaven is said to have been frequent and beatific. For a while, he confined his exertions and his teaching to his own family and kindred. Success, however, soon emboldened him to take a more ample range, and to display himself upon a wider field. Being constrained to fly from Mecca, in order to avoid the rage of his enemies, the citizens of Medina, who had already heard of his name and his pretensions, received him with open arms. Here he erected his standard, and declared his commission; with consummate art, he touched the predominating feelings of his countrymen, and filled their imaginations with the prospect of riches and glory. The effect exceeded his utmost expectation. Multitudes from every quarter enlisted themselves under his banners, anxious and zealous to propagate the faith, and longing to share the possessions of those who should call in question the authority of their leader. The fanaticism of the prophet now became more furious, and his artifice more profound; and his plans being at length mature, he proclaimed to the whole world the great dogma of Islamism, "That there is one true God, and that Mahomet is his prophet."

The system adopted by Mahomet was eminently calculated to ensure success. His mode of proselytism, though not extremely novel, was remarkable for its efficacy. Whoever refused to acknowledge his mission, was instantly put to death. It was with a naked sword in his hand, and with uplifted arm, that this military apostle preached the Koran. A logic so powerful was not easily resisted. After completing the conquest of Arabia, the leader of the faithful burst like a torrent into the Roman territories, and soon convinced the Christians, that whatever they might think of his arguments or his eloquence, his sword was not to be despised. Christianity, indeed, was now very different from what it once had been. The pure worship, the zeal of attachment, and the magnificent devotion of the early times, had in a great measure disappeared; and the church, torn with dissensions, enfeebled and listless, became an easy prey to its ferocious invaders. The means by which the disciples of Mahomet were retained and secured, were not less effectual than his decisive way of propagating the faith. The rewards of Islamism were neither remote nor spiritual; neither distant in the period of enjoyment, nor at all unintelligible to the sense. A fifth part being reserved for pious and charitable purposes, the spoil of the conquered nations was divided in equal portions among the soldiers. The true and faithful servant of the prophet was permitted to indulge in all sensual gratifications; he was allowed a plurality of wives, and he was assured that in the paradise of the blessed above, to which of course he was admitted, he should be attended by females (houries) of resplendent beauty, whose sole employment it should be to execute his commands, or minister to his pleasures. And it was declared to him, that his capacity for enjoyment would be enlarged and perfected, according to his means of gratification. The effect of all this upon a gross and voluptuous people, may easily be conceived. This, however, is not the whole matter. While by one part of the system, the love of pleasure was stimulated and gratified, by another part of it the fear of death and of danger was completely destroyed. The prophet of Mecca taught the doctrine of unbroken and immovable fatality. The world, he said, stood secure by the unalterable appointment of him who created it. The lot of man was fixed; no courage or dexterity could change it. To our destiny we must come. Why should we distress ourselves about future dangers, when these dangers cannot be prevented? Why should we harass ourselves with the fear of death? No concern of ours can stop the progress of dissolution. The fate of the world is not to be reversed; the glory of the prophet and of his followers is decreed; victory is on our side, and our names are enrolled in the records of the blessed.

The successors of Mahomet, not only propagated his doctrine, but imitated his example. Their arms were everywhere victorious; and such was the rapidity of their progress, that in little more than half a century, the whole of Persia, Syria, and Egypt, and a great part of Africa and Spain, had yielded to their irresistible valor, and acknowledged the dominion of the prophet.

CHAP. III.

The History of the Church of Christ, from the year 755, when the Supremacy of the Pope was acknowledged, and his Temporal Dominion established, to the era of the Reformation, about the year 1545.

This period may justly be denominated the period of darkness. It comprehends in it more instances of false opinion and elaborate folly, than all the other portions into which the history of the church may be divided. In this melancholy period, the religion of Jesus seems to be very nearly extinct, and imposture and fanaticism are dignified with its name. The historian finds himself lost amidst the aberrations of the human understanding, and the expressions of mistaken piety; and has to grope his way through the monastic institutions, and reliques, and canonizations, and indulgences, and to conduct his reader safe, amidst the interdicts of the popes, the battles of the crusaders, and the wrangling of the schools. To expatiate on all these topics, would carry us far beyond our limits; we shall only touch upon a few of them, and refer our readers to the accounts which are given, under the different titles, in other parts of the work.

In the beginning of the ninth century, the passion for accumulating the relics of the saints, appears to relics, have reached an extraordinary height. A respect for holy men when alive seems to have been extended to their corrupted remains after their death; and the more so, as every year brought new accounts of the miracles performed by these exuviae of the faithful. In consequence of his abstinence and his penances, the anchorite is supposed to have overcome the malignity of matter, and to have purified and refined it, by infusing a portion of his spiritual excellence into its native depravity. And matter, once believed to be the origin and the seat of all evil, is now represented as effectual in healing the sick, and in restoring the dead to life. Many persons, some of whom were in eminent stations, and others, distinguished by the learning which was prevalent at the time, travelled into Judea for the express purpose of obtaining relics. The bodies of the apostles and first martyrs are said to have been dug up, and innumerable fragments, bones, or pieces of bones, legs,
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arms, toes and fingers, skulls, jaw-bones and teeth, were brought into Italy. Very large sums of money were often paid for them; they were incased in gold, surrounded with precious stones, and worn as amulets about the neck. In some instances, the purchaser does not appear to have been extremely nice or scrupulous in his enquiries. If the bone presented to him was reported to have been dug up in Judea, or if it only looked like an old bone, or was in reality a rotten bone, he seemed content to buy it. Hence the knavery of the Greeks led them to substitute the remains of other animals for those of human beings, and particularly for those of the saints. And he who records the fulness of human credulity, will not fail to state, that many a devotee has wept over the leg or the spine of a dog or a jackass, and pleased himself at the same time with supposing that he had before him a relic of St Mark, St Bartholomew, or St James. Sometimes the remains in question were found in consequence of an immediate revelation from heaven; a holy monk, or female renowned for chastity, being directed to the place where they lay dispersed or interred. Many real crosses and fragments of them were obtained; and, last of all, the thirty pieces of silver with which Judas Iscariot was bribed, and which, by some confusion among the historians, are now called thirty pieces of gold, were discovered and known; and, passing through several hands, are still (it seems) possessed by the curious in relics, in different parts of the world. There is one of them "as large as an English noble," which is shown in the entrance to St Peter's at Rome. "But though the veneration for the remains of celebrated persons," observes an elegant writer, "when carried to such an extreme as to be converted into a species of religious worship, is certainly culpable; and though the miracles which were attributed to these remains, must be considered either as delusions of the fancy, or as forgery of priestcraft; still we are not to suppose the passion itself, without a foundation in the principles of human nature. It is impossible to confine the human affections in their operation; it is impossible not to connect the objects of our regard and our veneration, with every thing which was originally connected with them. The axe, which terminated the existence of the innocent and beautiful Anne Bullen, is still contemplated with some sensations of sympathy; and were it possible to survey the real cross on which the Saviour of mankind had been suspended, the person who did not consider it as more than an object of curiosity, must be destitute of all the most amiable feelings of the human heart."

Monastic institutions kept pace with the passion for relics. The monk (monk's) was originally a hermit or anchorite, who withdrew from society, and spent his time in solitary devotion. St Anthony the Egyptian is usually considered as the founder of monachism. He was ignorant in the very highest degree, and boasted of his ignorance; regarding learning as useless at least, if not pernicious. He was a severe ascetic and flagellant, lived much with the wild beasts, and supported himself upon fruits and herbs, the spontaneous productions of the earth. From Egypt and the East, monachism passed over into Greece. The Latins received it from the Greeks; and so highly was it valued in Italy, that, in the beginning of the ninth century, multitudes of persons, in all ranks and situations, withdrew from the world, and wasted their days in celibacy and solitude. The madness spread from province to province, and from one country of Europe to another; and even kings, dukes, and great lords of the court, forgot their true dignity as well as their duty to society, and joined with the poorest of their subjects or dependents, in all the severities of the monastic life. There is reason to believe that monachism, in its first institution, was the result of a sincere, though mistaken piety. Like the passion for relics, it unquestionably has a foundation in the principles of human nature. Beyond all doubt, it is wise and profitable to retire occasionally at least from the world, from its business and its allurements, and to prepare ourselves for an everlasting separation. In process of time, however, it was found convenient and desirable to relax the severity of the primitive institution. The fervour of fanaticism evaporated; mankind, too, became at length familiar with the tale of voluntary infatuation, and were less prompt to approve, and less vociferous in their praise; and the monks, in the course of a few centuries, contrived to join abstinence with the gratification of the appetites, to unite society with retirement, and the appearance of poverty with the possession of much wealth. The very nature of the monastic institutions afforded a solvo for the conscience. As individuals, the recluse were poor, but as a community they were rich; no one could boast of his acquisitions, yet the society grew daily in wealth and splendour. The monasteries were magnificent and commodious; to the eye of a stranger, they would have appeared rather as the palaces of princes, fully stored with all the luxuries of life, than as the cells of the anchorite, or the retreats of penitence. They were often not merely liberally, but profusely endowed. Many large estates had been conferred on some of them; legacies and bequests formed the riches of others. At one time a prince of the blood, having spent a long life in oppression and profligacy, made a liberal gift to some religious house, and conceived, that in this way he secured the forgiveness of his sins; and at another, a rich merchant, able to retain his wealth no longer, bestowed a portion of it upon the church. And by the invariable maxim of an artful priesthood, property once given to the church becomes ever after the property of God. It is sacrilege to touch it; a loud anathema is pronounced against him who shall convert it to any secular use.

Nothing appears too gross in the eyes of an ignorant and credulous people. The very dress of the monks was held to be possessed of peculiar and extraordinary virtues; and men of rank and eminence, when they found themselves about to die, often directed their servants to clothe them with the monastic vestments, "thinking that the sanctity of the garment would protect them against a condemnationary sentence of the omniscient Judge." False miracles, legends, and lies, were produced on every side. The multitude heard and believed. New followers of the apostles and evangelists were found out, each of them with a name and a history attached to it. Egypt and the East, in all their caves and cells, were peopled afresh: and the worthies lately enrolled and held up to the public admiration, were even more powerful than their predecessors, in protracted prayer, in exorcisms, and in their contests with the devil. The expression is somewhat coarse, but it has been justly said, that when the monks wanted a saint they made one, and when they wanted a miracle they made that too. Indeed it must be owned, that on subjects of this kind the greed of money was of a ready invention; and their facility in contriving is equalled by nothing but the prompt acceptance and capacious faith of those who swallowed the imposure.
Before Manichaeism was corrupted in the highest degree, the friars sometimes discharged the duty of the secular clergy. These last seem almost to have forgotten that they had any duty to discharge: they were, in truth, equally ignorant and remiss, and, in many instances, distinguished by all the vices which characterize the period in which they lived. Even on those rare occasions when they entered the pulpit, they conducted themselves in the most impious and shameless manner. Of this we have a remarkable example in the case of the Grecian Patriarch Theophylact. The prelate alluded to was by no means famous, either for his virtues in private life, or for his public performances as a functionary of the church. He sold, without scruple, every ecclesiastical benefice as soon as it became vacant, and converted the money to his own use. The writers of his times, (the 10th century,) have told us nothing of his dexterity as a patriarch in managing his clergy, of his integrity as a judge in the episcopal courts, of his commanding oratory or persuasive address; but they have given us very particular information about his excellent stud. He was, indeed, the very Nimrod of the middle ages, a mighty hunter; he had no fewer than 2000 horses in his stables, and these he fed with pig-nuts, pistachios, dried grapes, and figs steeped in wine. One Holy Thursday, when engaged in celebrating high mass, a groom brought him the intelligence that a favourite mare had foaled; upon which he instantly stopped short, threw down the liturgy, and running to the stable in an ecstasy of curiosity and dispatch, ascertained, by ocular demonstration, that the joyful news was true. And being now assured that a real and living foal was actually produced, he returned to the altar, took up the liturgy, and finished the service. It must be owned, however, that such flagrant instances were rare. Idleness and luxury, a tendency to political intrigue, and an insatiable ambition, are the vices with which the secular clergy are more justly charged. To these qualities, he added most profound ignorance. They seldom preached, for they could not compose; and they never studied, because they could not read. In the 12th, 13th, and 14th centuries, the sacred scriptures were little known. The volume of the New Testament was rarely to be found; many bishops had never once seen it in their whole lives: what they knew of its doctrines and precepts, they learnt solely from their missals. The people had no learning, and no sense of its value. At first the friars were somewhat more attentive to their duty than the secular clergy, enjoining at least the exercises of fasting and prayer. They even attempted to instruct the people in public; but their discourses had scarcely any relation to the Christianity of the sacred books, being chiefly occupied with the exploits of the saints; their power over the devil, especially in single combat; their watchings, fastings, and flagellations. When these topics failed, they had recourse to the virtues of holy water, crossing, and chrism. By degrees, however, all public instruction was given up; the darkness spread itself, thick and heavy, over the kingdoms of Europe; the intellect was degraded and enslaved; the curiosity asleep; and, at the period of the Reformation, it seems to have been universally held, that to repeat credo and ave mariae, in rapid succession, to undertake pilgrimages, to observe the holidays appointed by the church, and to pay the tithes and perquisites of the clergy, constituted the sum of religious duty, and formed the principal, if not the only excellencies of the Christian character.

Were we required to select any individual out of the whole fraternity of ascetics and recluse, who had influenced, in any remarkable degree, the opinions and the conduct of men, we could not fail to make choice of Peter the Hermit. And should we be asked to specify any one of the religious societies, whose principles and zealous activity have produced the most striking effects, we should be constrained to give, as our example, the society of the Jesuits. Let us now, therefore, introduce a short account of the extraordinary individual whose name we have mentioned, and of this notable society.

Peter, commonly called the Hermit, was born at Peter the Aniens in Picardy. In his youth he had been a soldier, and had served with reputation under the Count of Boulogne. It is not, however, in his military capacity, that we are at present to view him. In truth, he very soon relinquished the sword, and all worldly employments along with it. He made a tedious and painful pilgrimage to Jerusalem; and during his residence in that city and in Palestine, he beheld, with inexpressible concern, the sufferings which the Christians endured, from the tyranny and insolence of the Saracens. Immediately upon his return, he conceived the design of arming the sovereigns, and the people of Europe, in order to rescue the holy sepulchre from the pollution of the infidels. For this purpose he travelled from kingdom to kingdom, representing the sufferings of the pilgrims, and calling aloud for vengeance. He declared that he was willing to lead the armies himself, if no better general could be found: he spoke with confidence of special revelations, and preternatural assurances of success.

As he travelled from place to place, the Hermit exhibited, in his own person, the most complete specimen of monkish abstemiousness and frantic enthusiasm. His body, which was covered with a coarse garment, seemed wasted with fasting; his head was bare, his feet naked; he bore aloft in his hand a large and weighty crucifix, and his prayers were frequent, long, and loud. He accosted every person whom he met; and entered, without hesitation, both the palaces of the great and wealthy, and the cottages of the poor. If the power of eloquence is to be estimated by the effects which it produces; it certainly did not expire with Demosthenes and Cicero. The exhortations of the Hermit to repentance and to arms, roused the people from their lethargy: he painted the sufferings of the pilgrims in such glowing colours, that every heart was melted into compassion; and touching, with the hand of a master, the chivalrous spirit of the age, he challenged the brave to rescue their brethren from oppression, and to protect the holy earth in which their Saviour had been interred. Every eye kindled with indignation as he spoke, and the sword was already drawn to carry into effect the purpose of vengeance. Nor were these the only arts which were practised by this enthusiastic preacher. We have already hinted, that he built his hopes of success upon the assurances of heaven. He affirmed that Jesus Christ, and the holy Virgin his mother, had both appeared to him; and he mentioned the names of many saints with whom he had personally conversed. He even produced a letter, which he assured the people was written in heaven: it was addressed, he said, to all true Christians residing upon the earth, and its only object was to rouse their courage, and to animate their zeal, in the great and pious work which he urged them to undertake. This letter was...
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The crusade under Godfrey.

In consequence of the zeal and the labours of the Hermit, a very considerable sensation was produced in many parts of Europe. It seemed to be just and reasonable that the pilgrims should be relieved; and it was acknowledged as the will of heaven, that the holy sepulchre should no longer be defiled. Urban II. the reigning Pope, availed himself of the predominating feeling. He assembled a council at Clermont, in Auvergne. The prelates, great lords, and princes of Europe, with their numerous retainers, hastily obeyed the summons. No house could be found large enough to receive the multitude that were met together, and the deliberations took place in the open air. The pope himself, the head of all the churches, and representative of the true God, addressed the council: he made a powerful and deep impression upon the audience, especially the French who were present, and whose character, naturally susceptible and impetuous, rendered them the most proper subjects for the papal oratory. The hermit in his turn was not deficient. Plenary indulgence, and full absolution, were proclaimed to all who should devote themselves to the service of the cross. And such was the effect, that the whole assembly, as if moved by some divine impulse, cried out with one voice, "It is the will of God! it is the will of God!" Nor were these, by any means, words without import or consequence. An incredible number enlisted themselves in the sacred cause: peasants and artisans, nobles with extensive domains, and sovereigns renowned for their romantic valor, eagerly pressed forward, and requested permission to fight under the consecrated banner. Early in the year 1096, no fewer than 300,000 men, under the orders of Peter the Hermit, and Gautier or Walter the Moneyless, set out from the confines of France and Lorraine, and marched through Hungary and Bulgaria, to the capital of the Grecian empire. These, however, were an undisciplined rabble; laborers, indolent tradesmen, malefactors let loose from prison, monks and slaves; all, in short, to whom warfare was an amusement, or plunder was desirable. Many of them were partially armed, others were utterly unprovided with any military weapon. Behind this promiscuous and noisy assemblage, more like the collected banditti of Europe than a constituted soldiery, the regular troops advanced. These were men properly trained and appointed; conducted by the leaders of their respective nations or provinces, eager for the combat, as well as experienced in the field. By universal consent, the supreme command was conferred on the illustrious Godfrey of Bouillon, duke of Lorraine. He was supported by Baldevin his brother; Robert, duke of Normandy; Hugh, count of Vermandois; Raymond, count of Thoulouse; and Stephen, count of Blois. When the troops were numbered on the plains of Asia, they amounted to 700,000 fighting men. The fortune of the crusaders was various. Many of the soldiers died in battle, or perished through fatigue, and the diseases incident to the climate. In the end, however, the holy city was taken, and purified from infidel pollution; and Godfrey was saluted "King of Jerusalem" by all the troops under his command. The expedition itself has formed the subject of the well known epic poem of Tasso, a work inferior only to that of Milton, in modern times, if it be at all inferior; and ever to be named with those of Homer and Virgil, among the ancients, when we are verifying, by examples, the extent of the human genius.

If Peter the Hermit was remarkable, as an individual, for the effects which he produced on the opinions and conduct of men, the Jesuits were not less so as a society. The order now mentioned was founded by Ignatius Loyola, a Spanish gentleman, about the year 1540. It differed in many respects from all the other monastic institutions; its form of government, or ecclesiastical rule, was peculiar to itself; a great proportion of its members were trained to business, as well as to literature; and, instead of cultivating retirement, it was, from the beginning, a chief part of their duty to mingle with the world.

Loyola was equal to any of his predecessors in monkish austerity. He suffered his hair to grow, and cherished his nails to an extraordinary length; he begged from door to door—fasted, according to the statement of his biographer, six days in the week—whipped himself often—lay upon the ground without bedding—and spent seven hours of each day "in vocal prayer." To the austerity of the monk, he added the usual portion of fanatical zeal. He undertook a pilgrimage to Jerusalem—a circumstance which seems to have been necessary, in those days, to form the character of a perfect saint; and, in the course of his journey, he had many visions and miraculous adventures. Some say he had more than the requisite number of personal conflicts with the devil. His chief ambition, however, was to become the founder of a religious community. For this purpose, he produced a plan, or order, suggested, as he affirmed, by immediate inspiration; and hastening to Rome, presented it to the pope for his acceptance. Paul III., who at that time filled the chair of St. Peter, appeared at first inclined to reject the proposal of the zealous monk. Loyola, however, recommended his plan by an offer too powerful to be resisted. Besides the three monastic vows, of poverty, chastity, and submission to the rules of the order, he engaged, that all his followers should swear fealty and devoted obedience to the see of Rome—that they should acknowledge themselves the servants of the Pope, ready, upon the earliest signification of his wishes, to execute his commands, and to support his authority. The advantages to be derived from such an offer were instantly perceived. Paul III. immediately confirmed the institution, endowed the society with ample privileges, and appointed Loyola himself the first general of the order.

Among the Jesuits, the ecclesiastical rule put on the appearance of a simple and unlimited monarchy. The most implicit obedience was required from all the members of the society to the will of the superior. They were bound to yield up to him the very faculties and sentiments of their minds. "They were to listen to his injunctions as if they had been the commandments of Christ. Under his direction, they were to be mere passive instruments, like clay, to the hands of the potter, or like dead carcases incapable of resistance." The general himself was responsible to none but the Pope. In him were vested all the revenues and funds belonging to the society. He nominated, without partner, and without control, the provincials, rectors, and other functionaries of the order, and could remove them at pleasure. To him every novice was obliged to manifest his conscience; that is, to confess his sins and strongest propensities, and to lay open the inner recesses of the soul. And to him also, or to a person...
whom he should choose to appoint, the reports of the subordinate societies were regularly transmitted. These reports were minute and circumstantial in the highest degree, containing exact information respecting the characters of the novices and professed members, their talents, dispositions, and prevailing tendencies, and, above all, their knowledge of human nature, and experience in affairs. And thus the general, placed at the head of the whole institution, could issue his orders with the most perfect propriety; could appoint to each man his station, and to each man his reward; could allot the chief duties to the highest abilities; could elevate or degrade, exclude or retain.

By the fundamental principles of their constitution, the Jesuits were connected with the world, and almost necessarily involved in its business and troubles. Whatever tended to promote the instruction of the ignorant; to disseminate the true religion, either in countries already professing Christianity, or among Heathen nations,—and whatever contributed, or might be supposed to contribute, to the increase of the holy see, formed their province and care. Hence their chief study was human nature, and their chief art lay in managing and directing it. Hence they allowed no public transaction to take place without observation, for public transactions have much influence upon religion; and hence they attached themselves to the great and the powerful, for the time might come when their alliance and aid would be serviceable to the pope. They cultivated learning, because they perceived its use in governing mankind; and were not only theologians, but grammarians, critics, mathematicians, philosophers, and poets. Within fifty years after the institution of the order, they had obtained the chief direction in the education of youth throughout all the Catholic countries of Europe. The books "in usum Delphini," form a portion of the proofs which remain to us of their unwearied labour, and skill in the critical art. Nor were they satisfied with biasing the mind in early life; they were at the same time the spiritual guides of those more advanced in years. Every prince had his confessors, and that confessor was a Jesuit. In weak reigns, this functionary was superior in influence and authority even to the chief minister himself; and the politician, with all his foresight and address, was frequently constrained to yield to the intriguing skill and more successful activity of the monk. The whole society were closely united in promoting the interests of the order; to this paramount object all their efforts were directed; they corresponded with one another usually in cypher, and gave the earliest information; they were always upon the spot, and always attentive, dextrous, and persevering. Ambition was their fault, and the cause of their ruin; they had made large acquisitions of territory and of Indian subjects in South America, and unwise growing at independence, they provoked the jealousy of the European princes, and precipitated their fall. After a keen controversy with the Jansenists, and a considerable variety of fortune, the order was suppressed by Clement XIV. in the year 1773.

For an account of the inquisitorial tribunals, see Dominicans and Inquisition.

During the period which extends from the year 755 to the reformation by Luther, many strange and novel doctrines were introduced into the church. It would be altogether improper to call them heresies; for they were either propounded by the pope himself, and delivered from the chair of infallibility, as existing articles, or integral parts of the catholic faith; or they were generated in the schools, and growing into notice, were at length confirmed by the authority of the holy see. Of the doctrines alluded to, there is none more worthy of a place in ecclesiastical history, than that which relates to the presence of Christ's body and blood in the sacrament of the supper. Even so early as the 11th century, an opinion began to be entertained, that the bread and wine, when consecrated by the priest, were not mere symbols or representations. In the year 1201, the pope's legate enjoined the people of Cologne to prostrate themselves at the elevation of the host. The eucharist was no longer regarded as a commemorative rite; it was held to be sacrificial and propitiatory; the consecrated bread was represented as the victim, (hostis,) the Saviour himself was declared to be actually and substantially present, and to be really offered up to God as a sacrifice for the sins of the world; and the people were commanded to adore. But last we should err in giving our account of this monstrous doctrine, let us state it in the language of one of its most zealous defenders: "The bread and wine," says Humbert, on the confession prepared for Berenger, archbishop of Angers, who had maintained the opposite doctrine, "the bread and wine, after consecration, are not only a sacrament, but also the real body and blood of Jesus Christ; and this body and blood are handled by the priests, and consumed by the faithful, and not in a sacramental sense, but in reality and in truth, as other sensible objects are." This undoubtedly is broad and plain enough. It was regarded as no sufficient objection to the doctrine in question, that it contradicted the senses; it was a mystery, and mysteries, by their very nature, are difficult to be understood. Nor was it held sufficient to say, that the body of Christ was in heaven, and that, if we suppose it to be a real body, tangible and visible, it could not retain its qualities of length, breadth, and thickness, and yet be present in many places at the same time. The answer was easy, "we allow that the doctrine is mysterious." The words of Jesus likewise were quoted, as putting an end to the controversy, "this is my body, broken for you;" and though these words might have been considered as opposed to, and reduced in their signification by such expressions as the following: "I am the door, I am the vine, I am the way," &c. the doctrine of the real presence was believed, and with certain modifications, not very easy to be discerned and understood, it remains to this hour the doctrine of the Romish church.

Another of the doctrines which prevailed during the period above alluded to, was that of purgatory, or a temporary state of punishment in the world to come. Something resembling this doctrine, appears to have been taught in very early times; there are traces of it in the writings of Origen; and Gregory Nazianzen and Ambrose speak still more decisively concerning it. It may be inquired whether the intimations of a hades, or separate state, which are given to us in the scriptures themselves, ought not to be regarded as the foundation, on which the doctrine of purgatory was afterwards raised.

"In the tenth century, the fear of purgatory was carried to an extraordinary height, excelling even the apprehension of final judgment, and everlasting misery. And in later times, prayers and masses were continually offered up for the souls of those who had passed into this preparatory state; all the saints in heaven were supplicated, in order to shorten or mitigate the punishment, and rich gifts were bestowed upon the church. Some of the largest bequests which the clergy ever in-
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The season of sickness and the hour of death were the times when such donations, "for the good of the soul," were usually made. The dying transgressor readily parted with his possessions to secure the mediation of the saints; and all antiquity had declared, that the mediation of the saints was not to be secured without proper benefactions to the clergy. The following are the arguments by which the doctrine of purgatory is maintained: 1. As every sin, however inconsiderable, is an offence to God, it is deserving of punishment. 2. Many sins are so inconsiderable, as not to deserve everlasting punishment. 3 There must be a place or state of existence, where these inconsiderable transgressions are punished according to the measure of their enormity; and to this place, or state of existence, (say the Catholics,) we give the name of Purgatory. 4. There is no man who is altogether free from the stain of sin at the period of his dissolution. 5. There must, of consequence, be an intermediate state, a state of purification, where the soul is cleansed from all defilement, and the stain of corruption is completely washed away. And, (say the Catholics again,) we do nothing more than apply the name of Purgatory to this intermediate state.

The doctrine which relates to absolution and indulgence, must be mentioned in the third place. These two varieties of imposture have been joined together by the ecclesiastical historians, and with sufficient reason; for the tendency of both was to produce on the minds of men, one great and pernicious effect, namely, that of substituting the pope in the room of Almighty God, and establishing our title to the happiness of heaven, without the cultivation of personal virtue. While such doctrines and practices degrade the understanding, by subjecting it to the opinion and the authority of an individual, they relax at the same time the ties of all moral obligation. The power of absolution is one of those numerous consequences which result from what is technically called "the possession of the keys." We trust we need not repeat the arguments by which the Catholics attempt to support the exercise of this power. The extraordinary gifts which were conferred upon St Peter, were transmitted, (as they affirm,) to his successor the pope. And to Peter it is distinctly said, "I give unto thee the keys of the kingdom of heaven; and whatsoever thou shalt bind on earth shall be bound in heaven; and whatsoever thou shalt loose on earth, shall be loosed in heaven." It is more proper to observe, that the power of absolution was exercised in all its presumptuous and blasphemous extent, during the period of the crusades. In the course of these expeditions, few sins were left unpardoned. Simply to enrol the name in the lists of the sanctified soldiery, was held sufficient to secure the high blessing of unlimited forgiveness. The gates of paradise were opened wide to receive the consecrated battalions. The warriors of the cross were washed and cleansed by one deed of the pope, from all their iniquities. And in the thick darkness of the age, there were few who were able to search into the foundations of the papal authority, and few who were willing to expose its absurdity, even if they had had the penetration to detect it. Some planet seems to have struck the nations, or some fatality to have depressed the faculties of the human mind.

Indulgences, though producing nearly the same effects with absolution, may be considered as somewhat different in their description and history. And they are deserving of more particular notice, as it was the indiscrimet use of indulgences that provoked the opposition of Luther, and gave rise to the reformation in Germany.

The doctrine respecting this branch of the papal imposture, seems to be merely an extension of that which relates to penances. It was universally admitted, that it belongs to the church, upon sufficient considerations, to relax the severity of her discipline, to shorten the period of probation, and to lessen the number of penitentiary infictions. And it was granted likewise, that the church is the only judge of those considerations which she may hold to be sufficient. To allow therefore certain sins to be committed, without subjecting the individual to the usual penances, was supposed to be within the legitimate range and just exercise of the ecclesiastical power; and when the permission was signified in writing, the document alone, or the fact and the document taken together, constituted what, in the primary acceptance of the term, was called an indulgence. But the matter did not remain long in this situation. An additional import was given to the word; the practice was extended; and the remission of penances prepared the way for the remission of sins. If the individual was freed from all penitentiary infictions, in the former case, in the latter he was exempted from all punishment whatever; and if the indulgence was plenary, he might transgress with impunity every statute in the decalogue, and every ordinance of the church. To this favoured individual, purgatory, and even hell itself, were divested of their terrors; in the prospect of the last judgment, he was already acquitted. Nor were arguments wanting to support the doctrine and the practice which we have thus cursorily described. Indulgences were purchased; the error was lucrative, and a lucrative error never fails to find its champions in the schools, ready to arm themselves, and to sail on in its defence. "There actually exists," says St Thomas, "an immense treasure of merit, composed of the pious deeds and virtuous actions which the saints have performed, beyond what is necessary for their own salvation, and which are therefore applicable to the benefit of others; the guardian and dispenser of this precious treasure is the Roman pontiff; and of consequence he is empowered to assign to such as he thinks proper, a portion of this inexhaustible source of merit, suitable to their respective guilt, and apply the revenue to deliver men from the punishment due to their crimes."

From the tumult of the crusades, the blasphemous impiety of absolution, and the corruption of morals arising from indulgences, let us turn for a moment to the abodes of literature, and the retreats of philosophy. Here, perhaps, we may find something to rest upon with satisfaction; some light, however scanty, to diversify the scene; some straggling ray to prove to us that the darkness may yet be broken and dispelled. We must own, however, that we are far from being relieved or glorified by the change. The literature of the middle ages is occupied chiefly with the miracles of the saints; and the combats of the crusaders are surpassed in every thing, except the shedding of human blood, by the warfare of the schools. The Nominalists gave keen battle to the Realists, and the Realists, no less valorous than they, maintained the conflict. John the Sophist and the famous Roscelin led on the bands of the former, while the latter marched under the banner of Thomas Aquinas, and of Albert the Great. The doctors, subtle, irrefragable, seraphic, angelic, all mingled in the fray, and augmented the noise by very large accessions. The great question among these fierce disputers was,
whether the universals were things actually existing in nature, or whether they were merely words, that is, things existing only by designation. We trust our readers will see that this question was much more easily proposed than answered. In fact of point it proved to be so; but on that very account, it formed the better subject of discussion. Argument was held upon it after argument, and syllogism tried after syllogism; objections were made and rejoinders tendered, divisions took place, and deadly feuds were established. The learned every where engaged in the dispute, and all Europe rung again with the momentous controversy. Books were published; numerous and heavy comments were written, and annotations upon comments. Nor do we believe that this abstruse and subtle question is determined even at the present day. Our latest philosophers range themselves on opposite sides; Dr Reid embracing the opinion of the Realists, and Dr Berkeley and Professor Stewart attaching themselves to that of their more popular antagonists.

The question above referred to was one of breadth and generality. There were others, however, of a more particular nature; and some, if not very important in the result, were sufficiently amusing in the enumeration. Of these last the following are instances: "Can an angel pass from one extreme to another, without travelling through the middle space? When a man leads a pig to market, by means of a rope, is the pig led by the man or by the rope? (This question was propounded in a dispute about causes.) Is a Negro black or white? (answer, he is white accudum quid, that is, in relation to his teeth.) Other questions entertained in the schools were impious and blasphemous in the highest degree. We shall mention a few of these in the language in which they were originally proposed. An possible fiiit habere Mariam, placere filios, unica generatione, quid generetur verbum? An Maria dormiendo, habuerit umum rationem? An fuerit apostolus apostola, et omnium artium mechanicarum perita? An in statu innocentiae, aquilus numerius futurae fusilis, viroarii mulierem? An passere, el alia brevis ecclesiam fadantia licet ezcomunicare? An possitis baptizari aliquit, in lazioso, mulo, jure carnium, brodo piscium, urin? An tenet baptismus, si conferatur in nomine Diaboli? Utrum naturum mulieris, asini, serpenis, vel columbae? Christus deberet aut potuerit assumere? An haec similis propositiones, Deus est ujus, est scaramuzia, quae sint possibilis atque illa, Deus est homo? An pontifex Romanus, sit Deus, an homo, an ex utroque unum? From these questions, it will appear, that a reformation was no less necessary in the schools than it was in the church.

CHAP. IV.

The History of the Church of Christ, from the Era of the Reformation (inclusive) about the Year 1545 to the present Time.

In the year 1517, John Tetzel, a Dominican friar, began to publish indulgences in Germany, and to offer them for sale. He was employed by Albert, elector of Metz and archbishop of Magdeburg; and Albert himself was the immediate agent of Leo X. whose profuse munificence had exhausted the papal treasury, and induced him to replenish it by the most unjustifiable means. The indulgences in question were plenary, in the highest sense of the word; for Tetzel proclaimed the complete remission of sins, whether past, or present, or future, to all who could pay the stipulated sum. He who had money, or who had interest enough to borrow it, might transgress with impunity every precept of the decalogue, and set the justice of heaven at defiance. With an absolution already in his possession, nothing but the punishments of the civil magistrate could restrain him from committing the most atrocious wickedness; and, by the usurpations of the ecclesiastical courts, the number even of heinous crimes which fell within the jurisdiction of the civil magistrate was exceedingly small. The church, or, more correctly speaking, the pope, reigned triumphant; the prerogative of the Supreme Judge was violated and destroyed; and the thunderbolt of the divine wrath smote from the hand of Omnificence. All morality was relaxed—all government weakened—and all subordination and obedience appeared likely to cease; and the pernicious tendency of the doctrine was surpassed by nothing but the shameless impudence of Tetzel, and his associates, who published the indulgences, and magnified their value. The lives, too, of these unblushing apostles, corresponded with the nature of their mission; they often squandered, in low debauchery, the money which had been given by the pious and the simple, in the hope of obtaining everlasting happiness; and such was the perception of their worthlessness, and general opinion of their character, that even those who purchased the indulgences were ashamed to be seen in the company of the persons who sold them. The princes and great lords were provoked to find their subjects drained of their wealth, in order to supply the profusion of the sovereign pontiff; men of reflection, superior to the times in which they lived, marked the deep ignorance of the age; and men of learning anticipated a brighter era, or hailed the indications of its approach.

In these circumstances, it seemed good to the providence of Almighty God, to scatter the darkness, to put a stop to the accumulating corruption, to awaken inquiry, and restore the intellect of man to its original size and strength. The dominion of imposture, and the despotism of Rome, were now to be shaken. At the juncture of affairs which we have described above, there arose in Germany, the celebrated Martin Luther, a man of humble extraction, but endowed with penetration, with learning, and with courage, far beyond the proportion which falls to the lot of ordinary mortals. He was a native of Eisleben in Saxony, and in early life had entered a convent of the Augustine friars. Being speedily distinguished, on account of his piety, his love of knowledge, and unwearied application, he was appointed by Frederic the Wise, Elector of Saxony, to teach philosophy and theology in the university of Wittenburg. The prince just mentioned had lately founded the university, and was anxious to fill it with men who were celebrated for their learning.

Nothing is more certain, than that he who teaches others must first be taught himself. When knowledge is disseminated through the world, it is taken for granted, that some individual mind has previously been instructed. It would be gratifying, therefore, if we had it in our power to ascertain the endeavours and approximations, in consequence of which Luther's own sentiments were formed. It would be interesting as a philosophical inquiry, and it would be most satisfactory to the readers of ecclesiastical history, could we trace the steps by which this extraordinary individual was led to call in question the truth of the prevailing opinions,
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— to resist the authority of the pope— and to expose the insufficiency of his pretensions. But, whatever other helps Luther might have used, there is reason to believe, that his sentiments were formed, in a very great degree, by the perusal of the holy scriptures themselves. He drew his knowledge from the original source, pure and living; he sought Christianity in her first estate, and discovered her in all her native simplicity and beauty. There lay in an obscure corner of his monastery a neglected copy of the New Testament, to which his attention was casually directed; and having once begun to read in it, he commenced the study of the inspired volume, with all the eagerness and perseverance which belonged to his character. What must have been his emotions, when he contrasted the simplicity of the primitive institute, with the presumptuous pomp of the hierarchy and the papacy; and placed in opposition to one another, the humble follower of Jesus, and the mighty monarch, who reigned uncontrolled over the understandings and the consciences of men? What must have been his feelings, when he marked the terms of acceptance with God, as these terms are proposed to us in the sacred books, and bethought himself, for a moment, of the penances, and relics, and the intercession of the saints, and works of supererogation, and indulgences, and all the solemn trifling and elaborate mummery, by which the Church of Rome directed her votaries to the way to heaven! How different the language of inspiration, "believe on the Lord Jesus Christ and thou shalt be saved," and the language of the papal bulls, and even of the councils of Christendom!

At first, Luther contended himself with a bold and vehement opposition to Tetzel and the Dominicans. He declared against indulgences, in all the power of his eloquence, from the pulpit of the great church at Wittenburg; pointed out, with bitter reprehension, the vicious lives of the monks, their injustice, extortion, and vulgar debauchery; and, adopting already the first principle of Protestantism, he warned the people of their danger, in trusting for pardon and acceptance with heaven, to any other means than those which God had appointed in his word. The pope, he said, might unquestioningly remit the penances which he had himself imposed, or dispense with the ceremonies ordained by the church; but it belonged to the Supreme Judge, and to him alone to forgive the trespasses of the moral law. To the pope, he acknowledged that he owed all submission; and he even spoke of referring the question at issue between him and his antagonists, to the decision of the sovereign pontiff. From this, it is evident, that the sentiments of Luther, with regard to the powers of the papacy, were not yet mature; and had Leo X. conducted himself on the present occasion with the prudence often displayed by the successors of St. Peter, the dispute might either have been terminated among the combatants themselves, or left undecided altogether; and historians would have handed it down to us as nothing more than a contest between certain ecclesiastics in Germany, scarcely deserving of particular notice. But the temper of Leo appears to have been violent, and his cause was radically bad: by threats and ferocious dogmatism, he roused the courage and sharpened the acuteness of the reformer, induced him to prosecute his inquiries, and in the end gave occasion to that memorable rupture, which has rent asunder the Christian church, and shaken, even in its own estimation, the supremacy of the holy see.

If ever there was a time when threats and dogmatism were improper to be used, it was the time of the controversy between Luther and the agents of the Pope. The era of ignorance was now hasteing towards its close. The human mind was quickened and stimulated, the intellectual eye began to open, learning had revived, books were printed and circulated, inquiries were made, and investigations pursued. The reverence for antiquity was already much abated; and mankind now looked for argument in the decision of theological as well as philosophical questions; or if authority was referred to, they proceeded to examine the grounds on which the authority was built. Reformations were talked of; abuses specified; the names of Wickliffe and Huss were mentioned with respect; whispers were abroad unfavourable to the honour of Rome, and the security of the papal power.

At this most auspicious time, Leo X. and his agents proceeded against Luther, wholly in the way of despotic authority and simple recantation. The reformer was summoned to appear at Augsburg, before Cardinal Cajetan, a Dominican monk, at once the friend of Tetzel, and the undisguised enemy of the new opinions. The cardinal, who had the reputation of learning, and was at the same time the pope's legate in Germany, was imprudently nominated sole arbiter in the cause. Luther, though he perceived from the beginning, that little was to be expected from the impartiality of the judge, repaired to the place appointed, ready to defend the sentiments which he had published, and animated with a courage which nothing could resist. The event corresponded exactly with the anticipations of the reformer. The cardinal stood high upon his dignity, refused to enter into a dispute with an Augustine monk, would listen to none of the reasons with which Luther endeavoured to support his opinions, and required him, "by virtue of the apostolic powers with which he was clothed, to retract his errors in regard to indulgences and the nature of faith, and to abstain, for the future, from the publication of new and dangerous doctrines." Nor was this all. The reformer was not only commanded to retract and to abstain,—he was also commanded to believe. And for the accommodation of his understanding, and as the subject of his belief, the cardinal pronounced to him, in consequence of the apostolic powers which he has just allowed, to the following authoritative dogma: "That one drop of Christ's blood being sufficient to redeem the whole human race, the remaining quantity, which was shed in the garden and upon the cross, was left as a legacy to the church, to be a treasure, from whence indulgences can be drawn and administered by the Roman pontiff." The answer of Luther was temperate, yet firm. He declared, in direct asseveration, that he could not renounce those opinions which he held to be entirely consonant with the sacred scriptures; and that nothing should ever induce him to do what he conceived to be so unworthy in itself; and so dishonourable and offensive to God. He expressed his willingness, at the same time, either to reason the matter to an end with the cardinal himself, or to refer it to the decision of certain universities which he named. He even went so far as to engage that he would abstain, in all time to come, from preaching or writing against indulgences, provided his enemies were enjoined to observe a similar silence with respect to them. This equitable and moderate conduct, however, and those concessions, had no effect upon the cardinal. He still insisted upon a simple and unqualified recantation. He branded Luther with the name of a schismatic, and stigmatized him, as indeed the pope himself had already done, in several of
his briefs and letters, under the characters of a child of
iniquity, and a man given up to a reprobate sense. And
such was the tyrannical violence of this lofty prelate,
that the reformer, after solemnly appealing from his
judgment, to the more mature deliberation and decision
of the holy see, complied with the earnest intreaties of
his friends, and withdrew himself privately from Augs-
burg.

From what we have stated, however, our readers will
easily perceive, that an appeal to the pope was both un-
wise and unnecessary. The dispute respecting indul-
genesis affected not only the authority of the papal chair,
but the revenues of the pontiff. The cultivated magni-
ficence and the splendid liberality of Leo, required ex-
tensive funds. By diminishing the value of indulgences,
the profits of the sale were lessened. One country of
Christendom would imitate another; the resources of
the church would be impaired; and who does not know
that the power of the pope has always been intimately
connected with the resources of the church? But the
appeal in question was unnecessary, as well as unwise.
The court of Rome had already decided against Luther
and his followers. The sovereign pontiff had declared
the new doctrines heretical; and a bull was in agitation,
to cut off the schismatic monk, and to cast him out from
the bosom of the church. The document, if it may be
called so, was very solemnly pronounced. The whole
college of cardinals were consulted upon the occasion,
and were repeatedly assembled, in order to select the most
objectionable passages from the writings of the reform-
er; and the schools were ransacked to procure some able
canonists, that the sentence might be expressed with
unexceptionable formality. At length, on the 15th day of
June, A.D. 1520, the bull, so fatal to the
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This famous bull had no other effect upon the mind
of Luther, than that of exciting him to keener opposi-
tion, and more systematic hostility. He had perseve-
red with habitual diligence, and with humble prayer
to God, in the study of the sacred scriptures. He had
read of the "man of sin," the antichrist who was to
come in the latter days of the church; that power
which was to oppose itself to the interests of true reli-
gion, and the dominion of the everlasting God. He
marked the resemblance between the descriptions of
this power given to us in the sacred books, and the un-
justifiable pretensions and blasphemous arrogance of
the holy see. He noted the distinguishing circumstances
alluded to in the particulars, of "sitting in the temple
of God, (referring to the man of sin,) and showing him-
self that he is God, of "lying wonders," and the " de-
ceivableness of unrighteousness," of " forbidding to
marry," and "commanding to abstain from meats," and
rewriting the whole matter in his mind, he next
boldly pronounced the Pope to be the man of sin, and
the power of the Romish church to be the deadly power,
which should raise itself, in the latter days, against
the sovereignty of Christ. Amidst a vast assemblage of
people in the town of Wittenburg, he threw the papal
bull, and the volumes of the canon law, into the flames;
appealing to a general council, which he declared to be
the only tribunal where his case could be judged, and
to which, in the opinion of Christendom, the pope him-
self was subject. He warmly exhorted the princes of
Europe to shake off the yoke which they had too long
borne, and too ignominiously borne; and offered thanks-
givings to Almighty God, that he had been selected as
the advocate of true religion, and, according to the mea-
sure of his abilities; as a friend to the liberties of man-
kind.

Nor was the voice of the reformer lifted up in vain. The Re-
formation found supporters in almost every
kingdom of Europe. In Switzerland, Ulric Zwingli,
a man of a republican spirit, attacked the ancient su-
perstition, with a courage by no means inferior to that
of Luther himself. The elector of Saxony was the pa-
tron of the Reformation. Most of the Prussian princes
joined with the elector. The edict of Worms, which
was unfavourable to Luther, could not be executed.
At the same diet in which the edict alluded to was pro-
nounced, it was resolved, that every secular prince
should manage the ecclesiastical affairs of his own do-
minions, as he himself should judge to be most proper,
till the meeting of a general council. We must own,
however, that at a subsequent diet, this wholesome
resolution was reversed; but we must not fail to state,
that against the sentence of reversal, the elector of
Saxony, the landgrave of Hesse, the marquis of Bran-
denburgh, together with the princes of Luneburgh and
Anhalt, and the representatives of fourteen Imperial
cities, entered their most solemn protest. They decla-
red the sentence to be unjust as well as impious.
From the circumstance of protesting on the part of the
princes and representatives, mentioned above, the name of Pro-
testants had its origin; a name since applied to all
the variety of sects which have withdrawn, upon any
account, from the communion of Rome. The sacred
scriptures were translated into the German tongue, and
were read with astonishing avidity. Melanchthon, who
had assisted Luther in the translation, drew up the
conciliatory creed, entitled the "Confession of Augs-
burg." The league of Smalcalde was formed, and the
Protestant states were united into a regular body.
The Helvetic cantons, under the auspices of the famous
John Calvin, proclaimed aloud their determined hosti-
ity to the rites and ceremonies of the papal institu-
tion.
The secret friends of the Reformation abounded in
France, Spain, Hungary, Bohemia, and the Nether-
lands. And to crown the whole, King Henry VIII. of
England, after writing in defence of the papacy, and
obtaining from the holy see the title of "Defender of
the Faith," suddenly deserted the cause which he had
espoused, and commenced a rough and hasty, but ef-
fectual reformation throughout his dominions, dethron-
ing the pope, and with blustering magnanimity, sub-
stituting himself in his place.

Still, however, the enemies of the Reformation were
both numerous and powerful. A very great proportion
of the European princes remained attached to the an-
cient system; some of them from religious considera-
tions, and others from motives of interest or policy.
Among the last class we must reckon the Emperor
Charles V. It was in opposition to this monarch that
the league of Smalcalde was formed; and during a
considerable part of his reign he was engaged in open
war with the Protestant leaders. The sovereigns of
France, Spain, and Portugal, continued to acknow-
ledge the powers of the holy see. All the Italian states
remained submissive to the pope. The numbers on both sides were great; the interests jarring, yet weighty; but the strength of argument, and the power of eloquence and of truth, belonged chiefly to the Protestants. They rejoiced in the exercise of their faculties, emancipated and enlarged; they published their opinions, and challenged a investigation. True religion is ever friendly to inquiry; it is error alone that hastens to hide itself in darkness. Every new discovery which was made in the arts, or in the sciences, and every copy of the holy scriptures that was printed, conveyed additional light to the understanding, and gave additional vigour to the champions of reformation.

In this situation of affairs, and when religious disputes were about to be settled by an appeal to arms, the council of Trent was unexpectedly convoked. It was summoned by the authority of the pope, and sat down, at the place from which it takes its name, in the year 1545. Strange as it may appear, the Catholics were now the most forward in demanding a general council; and those ecumenical assemblies, which in the preceding ages were the terror and the abhorrence of the popes, were at length convoked, if not with greater alacrity, at least with fewer objections. The weakness of human nature had been duly estimated. The court of Rome, always intriguing in its character, and rendered dextrous by long practice in affairs, perceived that general councils might be influenced and managed as well as other bodies of men. It was easy to throw difficulties in the way, and make it disagreeable or inconvenient for the Protestant leaders to attend; some of the members might be flattered into acquiescence, and others overawed. Bribes were to be tried in the first instance, and if these were found to be unavailing, threatenings might be employed.

But the cause of Protestantism, identified as we must conceive it to be with that of true religion, suffered about this time in a very different way. Luther, the great father of the Reformation, died at Eisleben in Saxony, on the 18th of February 1546. His health had for some time been declining, and his constitution, naturally strong, was exhausted with incessant study, and that agitation of mind to which controversy almost necessarily gives rise. To a zealous regard for truth, he added an apostolical intrepidity in its defence. His manners were pure, perhaps even austere; his diet was plain; his whole mode of living characterized by a primitive simplicity. He knew nothing, and wished to know nothing, of the elegancies which belong to cultivated society; he was satisfied with the emoluments of his professorship, and left the preferments and honours of the church entirely to his disciples. Upright in his intentions, and fair and direct in all his conduct, man could justly charge him with duplicity; he disdained the crooked artifices of little minds; but his zeal was often excessive, his temper inflexible and haughty, and his language, especially in controversy, contumacious and coarse. Yet there was, in this coarseness, a barbaric strength; and such was the power of his opposition, that it was not safe for any one who valued himself upon his literary reputation, to awaken him into rage. His piety was very great and sincere; and, in his last moments, he discoursed to his friends of the happiness of heaven, with a fervour and delight which could result from nothing but a well-grounded hope of immortality. He left a character to be imitated almost in every thing but the excess of his zeal: nor will the friend of genuine Christianity, of literature, or of liberty, ever mention his name, but with the gratitude and reverence which are due to the benefactors of mankind.

We return, however, to the narrative of events. When the council met, in obedience to the papal mandate, it was found to consist almost entirely of the Italian and Spanish prelates. In the first session, there were present only the Pope's legates, who presided, four archbishops, and twenty-two bishops; yet a considerable number immediately declared themselves to be a general council, and proceeded to determine controversies, and to enact laws for the benefit of the church. The subsequent sittings were better attended; but still the Italian and Spanish clergy formed by far the greater part; and, even of these, some who were refractory, and who spoke of abuses and reformations, were awed into silence by the overbearing authority of the papal legates. The Protestant leaders had long ago declared the jurisdiction of the council; they would not allow it to be a synod properly convoked; and far less would they acknowledge it as an ecumenical assembly of the Christian church. Everything, of course, was transacted according to the despotic will of the holy see. The case of St Peter, whom the Protestants have justly described as the most blundering of all the apostles, was introduced, and argued at large. In the eye of Catholic interpretation, St Peter was the shepherd, and the Christian world were the sheep. —"... silly animals," as Lainez, the general of the Jesuits, expressed it, "which have no part or choice whatever in conducting themselves." St Cyprian, too, (observed the general), compares the apostolic see to the root, the head, the fountain, the sun; shewing, by these comparisons, that the supreme jurisdiction resides in her alone; and that it exists in others only by derivation and participation. And this is the meaning (continued he) of the ancient language, when it is said, that St Peter and the Pope possess the plenitude of power, while others do nothing more than participate in the cure. To the arguments of the general, no effectual reply was made. The authority of the Pope was confirmed in all its extent and latitude. The French ambassador alone appears to have spoken in favour of the Protestants, declaring that, so far from being the cause of the troubles which existed in France, they were the injured party. He plainly stated, that abuses had crept into the church; that reformations were necessary; and that his most Christian majesty, and the whole French people, expected nothing less than certain very considerable changes. And he requested, in the name of his master, that the council should not satisfy themselves with enacting laws, but that the Pope and the clergy should make use of their power, in order to carry them into execution. "If the "father," said he, "should ask, why France is not in peace?—no other answer can be given, than that which Jehu gave to Joram of old, What peace (can there be) so long as the whoredoms of thy mother Jezebel and her witchcrafts are so many?"

But if the council were unwilling to reform abuses, or to acknowledge their existence, they were sufficiently attentive to the security of their own rights and privileges. They enacted many statutes, the tendency of which was, to secure the ecclesiastical orders from all interference on the part of the civil powers. By the spirit, and even by the letter of these statutes, no clergyman could be tried in any secular court. He was responsible, indeed, in matters of civil delinquency; but, with the exception of a few cases, peculiarly aggravated, he was responsible only to the judicatories of the church. And, even in the excepted cases, it was
determined that the trial of an ecclesiastical before the secular judge must be preceded by a declaration or permission from the episcopal court. The property of the church is pronounced to be sacred: the clergy cannot be compelled to pay taxes, even under the name of loans or free gifts, whether those taxes, loans, or free gifts apply to their patrimonial possessions, or to the goods belonging to the community. The mandatory letters, sentences, or citations, of the ecclesiastical judges, are to be executed without inquiry or delay. From the enactments now alluded to, as well as others of a similar description, which our limits prevent us from specifying, we may form some idea of the height to which sacerdotal presumption was carried in the sixteenth century, and of that independence upon the civil authorities to which the exertions of the Roman church were so long and so unjustly directed.

But while the council were at all pains to secure their own rights and privileges, they found it necessary to put forth a statute, "concerning the rule which should be held as supreme and decisive, in matters of faith." An ordinance relative to this important particular, was imperiously demanded by the progress of the Reformation; and it was chiefly with a view to ascertain the opinion of the church with regard to it, that the council had been convened. Accordingly, at their fourth sitting, and when only forty-nine members were present, they promulgated their famous decree respecting the canon of scripture, and the value of the apostolical traditions: a decree which pronounces the apocryphal books to be of the same authority with those which are genuine, and which places the traditions of the fathers on a level with both; an enactment which declares, that the Vulgate Version of the Sacred Scriptures, though not written, as its very title implies, either in the ancient language of the prophets, or in that of the apostles and evangelists, is nevertheless to be received and used throughout the church, as authentic and canonical. Of this notable decree, the following is a short account. It is solemnly determined, "that the books to which the designation of apocryphal hath been given, are of equal authority with those which were received by the Jews and the primitive Christians into the sacred canon; that the traditions handed down from the apostolic age, and preserved in the church, are entitled to as much regard as the scripture and precepts which the inspired authors have committed to writing; and that the Latin translation of the Scriptures made or revised by St Jerome, and known by the name of the Vulgate Translation, shall be read in the churches, and appealed to in the schools, as authentic and canonical;" and all persons who refuse to subscribe these tenets, are anathematized, and cut off from the communion of the church. Upon this decree, which has occupied so much attention, and been the topic of so much discussion since the era of the Reformation, we shall make only one or two additional remarks. First of all, when the council were employed in concocting it, they seem to have felt very indignant that pedants and grammarians (petits maîtres de grammaire) should presume to contend about the meaning of scriptures with doctors in theology. And, secondly, while they pronounced the Vulgate Version to be authentic and canonical, they appointed, at the same time, a committee of six persons, apparently the whole number present that were acquainted with the original languages, to revise and correct it.

The statute concerning the rule of faith.

Such is the well known decree of the Tridentine council, with regard to the rule of faith. It had passed with some difficulty, and not without considerable argumentation, even among the small number of members who were present. No sooner, however, was this famous decree promulged, than the pope, representing himself as superior to the council, and ultimate in decision, confirmed it by his apostolical authority, prohibiting at the same time all Christians, in communion with the holy see, from writing notes or comments upon it. They were not even allowed to illustrate or to defend it, without the permission of the sovereign pontiff.

Having confirmed the decree respecting the rule of faith, as well as the other acts of the council, the next step, on the part of the pope, was to procure the formal and implicit acknowledgment of the whole, by the different nations of Europe. The Venetians, with a dutiful submission to the supreme ecclesiastical authority, readily acquiesced. The Poles likewise expressed their willingness to abide by the decisions of the council. The Spaniards, too, manifested a considerable promptitude of comprehension and compliance; though in some provinces the Tridentine decrees were received with certain murmurs, doubts, enquiries, and reservations. It was thought that the episcopal order was too much reduced, and the powers of the papacy extended too far. Among the German Catholics, there were many who objected. But the most refractory of all the papal subjects were the French. No commanding attitude on the part of the holy see, nor stratagem of ecclesiastical dexterity on the part of its devoted agents, could induce the Gallican church to accept of the Tridentine decisions. They specified no fewer than twenty-three articles which, as they affirmed, were directly opposite, even in the very letter of the enactments, to the ancient usages of the realm; and they pronounced them to be equally destructive of civil and of religious liberty. "In all which particulars," says the celebrated Pasquier, alluding to certain portions of the twenty-three articles, "we have found such a repugnance and contravention to our ancient liberties, that we can never be induced to receive this council. For, first of all, it takes away from the bishops the power of reforming the churches which are situated within their own dioceses; and grants them only such a measure of power as the holy see shall think proper to allot them; a procedure which we believe to be contrary with the ancient canons approved of by the Gallican church. And besides this, the council seems desirous of establishing a new empire over kings, princes, barons, and every civil jurisdiction; which, in plain language, is to introduce old abuses which we have long ago reformed. Whereas, I can demonstrate, that our national privileges, and the liberties of the Gallican church, are such as the authority of neither pope nor council can abrogate, being founded on the broad and sacred reason of things (sur une raison auteur et générale.) By the admission of such decrees, (continues he), instead of securing order, we should bring in disorder, and introduce at the same time a monarchy, a thing which we have never hitherto beheld, into the middle of our own. Wisely, then, has this council never been received in France, by which, with a single stroke of the pen, the pope would acquire more authority than he has been able to do since the commencement of our common Christianity. I have no intention, (observes the same writer,) to deprecate the good Fathers of Trent; but I cannot help wishing that their zeal and devotion had been accompanied with a little more wisdom and discretion; and that in guarding the pretended
privileges of the holy see, they had not furnished its real enemies with the fittest weapons to overthrow it."

From the short account which we have just given of the Council of Trent, our readers will easily perceive, that we have no means likely to put any stop to the progress of the Reformation. It was considered by the patrons of the new opinions, as the exertion of a power which felt itself to be unstable. Its authoritative decisions were ridiculed by the Protestants, and even the Catholics have ceased to regard and to observe them with their wonted veneration. The revolutionary spirit appeared, by indications not to be questioned, in many of the kingdoms of Europe. In England, the changes were both numerous and radical. The reformation of Henry VIII. were no less effectual than hasty and tumultuous. He was declared by his parliament to be "the supreme head, on earth, of the church of England;" and he proceeded, not only to secure the property belonging to the monasteries which he had suppressed, but to fabricate, with all his royal diligence and skill, a suitable creed for the English people. History may record him as the first layman who took to himself, in the ecclesiastical sense of the expression, the title of supreme head of the church. The rough reformation of Henry, were succeeded by the more deliberate and steady measures pursued by the government, during the minority of Edward VI. The Bible, which had been translated into English, was allowed to be more generally read; a new liturgy was composed; and the service was performed in the vernacular tongue. The persecutions under Mary, in the course of which the virtuous Ridley, and the aged Latimer, were put to death, terminated with the reign of that inatuated princess, Elizabeth, her successor, openly avowed and protected the new religion. The sacred scriptures, together with the liturgy and the homilies, were freely circulated. The efforts of Spain and of Rome to restore the dominion of the papacy, were crushed by the defeat of the celebrated armada; the Scottish Catholics in the interest of their beautiful and unfortunate queen, were no less unsuccessful; the parliament united with the sovereign and her ministers; a very great majority of the nation supported the measures of the executive; and the reign of Elizabeth, though its full brightness is shaded by some acts of cruelty, must ever be regarded as that illustrious period, when truth and genuine Christianity secured for themselves a place, and established their abode among the English people.

In Scotland, the Reformation was effectuated by different means. Here we are constrained to look, not to the ruler, but to the subject. In the country alluded to, the Reformation could not, with any measure of propriety, be denominated a contest between the sovereign and the holy see, about the possession and the exercise of unlimited power: At the commencement of the changes, the civil and ecclesiastical authorities were not opposed. In this country, the Reformation took its rise from beginnings almost imperceptible. It was a poor man who achieved the mighty work in our native land. We hail the father of Scottish independence, the magnanimous Knox; at once the champion of truth and of liberty; stern, indeed, in his aspect, and fierce in his opposition, but stern only towards those whose iniquities he reproved, and fierce only when summoned by the mandate of heaven to arouse his courage, and to "wax valiant in fight." To his unwearied exertions, we owe our emancipation from an enslaving superstition, our successful system of education, the intelligence of our people, the discipline of our ecclesiastical polity, and whatever remains of genuine piety in the remoter provinces and sequestered vales of the country to which we belong. We venerate his honored name, and rejoice that a biographer has at length appeared, who has done justice to the character of the Scottish reformer, and, at the same time, has secured for his own performance an abiding place among the literature of the nation.

With the exception of the miraculous powers, the weapons used by Knox were the very same weapons with those which were employed by the apostles in the early period of the church. It was chiefly by the "preaching of the word" that the Scottish reformer accomplished the great work which he had undertaken. Though of an inferior stature, and of an appearance little engaging, his eloquence was efficacious in the highest degree. During the circuit of the country which he made soon after his return from the continent, he produced an extraordinary change upon the sentiments and feelings of the people. Multitudes from every quarter of the kingdom attended him, and eagerly listened, while he proposed and explained to them the doctrines of the Reformation. Every eye was fixed upon him, and every heart throbbed with emotion, as he prayed for deliverance to the enslaved land. The mind sprang forward, rejoicing in its liberty, and the courage even of the fearful arose. "Come out of her, my people," was the divine command; and never was it pronounced in allusion to a church so gross and festering with corruption, and never, since the times of inspiration, was it pronounced with greater energy, or with more important results. No speech uttered even by Demosthenes himself, in all the mighty fierceness of his declarations, was ever followed by such effects as the sermons of Knox. With the irresistible power of truth and of heaven, he took possession of the understanding, and captivated the affections. Undismayed by opposition, and not fearing the face of man, he overlooked all distinctions between the rich and the poor, the great and the humble; and addressing them indiscriminately in the character of guilty and condemned creatures, he proclaimed to them, with apostolical energy, the "glad tidings" of pardon and of peace. The sinner trembled under the denunciation of punishment, and the desponding were comforted and established in their most holy faith.

It is to be regretted that the zeal excited by the discourses of Knox could not uniformly be restrained within the limits which he himself would have prescribed for it. The multitude, animated and inflamed by the eloquence of the reformer, and moved likewise in a very considerable degree, by the imprudence of the Catholic party, proceeded, with ungovernable fury, to destroy the objects and the monuments of the papal worship. The images, relics, and altars, were broken in pieces; some of the religious houses shared a similar fate: the barriers were removed; the waters were out; and in the overwhelming tide and fierceness of the inundation, the superstitions of ancient times were swept away from the land. We are not aware that the destruction of the images and relics is to be lamented with extraordinary sorrow; but antiquaries and architects have wept, and perhaps not without sufficient reason, over the fate of the monasteries. Let it be remembered, however, that when the machinery of superstition was broken, the superstition itself was annihilated. The doctrines of popery, considered as distinct from the authoritative enactments of the holy see, had no possession and no...
place in the public mind; it was a system of external observances; and when the tools by which the work was carried on were destroyed, the work itself could no longer be performed. To remove the means of iniquity, is, in many instances, to put an end to its existence.

But it was not only on the minds of the people, that the eloquence of Knox produced its effects. Many of the nobility attached themselves to the cause of the Reformation. There is reason to believe, that a considerable number of these were actuated by a sincere regard for the interests of religion, and the welfare of their country. With others, the motives were of a mixed and doubtful nature; and not a few appear to have adopted the new opinions, because the success of the Reformation afforded them the immediate prospect of seizing and appropriating the ample possessions of the church. The meetings of the Protestants, were attended by the great lords and their retainers, in arms. The Earl Marischal and Glencarn were at once the disciples and the protectors of Knox. A powerful party, variously composed, existed in the country; and, by uniting themselves in the articles of covenant, for mutual support and defence, they at once assuaged their number, and concentrated their strength. The political events, so well known to every reader of Scottish history, facilitated the progress of the reformers. The inauspicious marriage of the young and beautiful queen, the murder of Darnley, the infamous conduct of the Earl of Bothwell, the zeal, the valour, and the prudence of Murray, all conspired with the labours of the preachers, and the increasing intelligence of the people; till at length the public voice became nearly uniform, and whenever the public voice becomes uniform or nearly uniform, the experience of ages will tell us, that it is neither to be trifled with, nor resisted. The parliament of the nation supported and confirmed the sentiments of the people. The Papacy was abolished; even the order of bishops was completely subverted; and Presbyterianism, a system, the leading principle of which is, that every teacher of religion, shall employ himself in the work of instruction among the people committed to his care, was established and acknowledged throughout the country. This wholesome system has ever since been fondly cherished by the Scottish nation; nor could all the efforts of the English court in later times, a court professing a regard for Episcopacy indeed, but secretly and slavishly devoted to the cause of Rome, induce them to swerve, even in the slightest degree, from the doctrine and the institute of the great reformer of their church. More than twenty years of cruel persecution, and of military apostasy, were tried in vain. Their attachment remained unbroken; and Presbyterianism, continues to this day the object of sacred estimation, in the eyes of the Scottish people.

For an account of the progress of the Reformation in France, the massacre of St. Bartholomew, and that which followed the revocation of the edict of Nantz, see France.

The doctrine of the Protestant churches is the next topic which demands our attention. This doctrine, as it is, in many important and prominent particulars, to the articles of the Romish faith, is detailed at considerable length, in the creeds and confessions, which have at different times been published by the chief persons and societies of the Reformation. The "Confession of Augsburg," which is understood to represent the Lutheran tenets, has been mentioned above. The doctrine of the English church is contained in her XXXIX Articles; and that still adhered to in Scotland, is to be found in the Confession of Faith, and in the Larger and Shorter Catechisms of our national church. In the Scottish formularies, the peculiar doctrines of the Holy Scriptures are supposed to be more amply and distinctly set forth. It is worthy of notice, however, that in all the creeds and confessions above alluded to, there is a very remarkable agreement; a harmony so conspicuous indeed, as well as gratifying, that the reader, by carefully consulting any one out of the whole number, may arrive at a sufficient degree of information, respecting the doctrine professed and maintained by the reformed communities. To one or other of these formularies, therefore, we refer our readers; and shall proceed to offer a short account of the most important controversies which have been agitated among the Protestants, since the time of Luther to the present day.

When the leaders of the Reformation withdrew from the communion of Rome, they separated from her by different stages of removal, and with different degrees of aversion. Of all the distinguished individuals among the Protestants, Melancthon appears to have retained the greatest attachment to the ancient church. He was a person extremely gentle in his dispositions, and he seems to have thought that by mutual concessions and approximations, the peace of the church might be restored and established. In one particular, the doctrine maintained by Luther himself, appears to have been removed only a short way from the corresponding article of the Romish faith; and, with regard to this one particular, the Father of the Reformation was long engaged in controversy, even with those who agreed with him in the general system of his belief. The particular to which we allude, is that very mysterious one, respecting the body and blood of Christ in the sacrament of the supper. It is true, that Luther denied and rejected, with abhorrence, the doctrine of transubstantiation, and would by no means allow, that the sacramental bread was converted into the real body of Christ. But while he denied any conversion of this nature, he strenuously maintained, that though the eucharistic bread continued, after the solemnity of consecration, to be nothing more than bread, the real body of Jesus, distinguished of course, as we should be inclined to think, by the usual material qualities, extended, visible and tangible, was present along with the bread. In short, he held the doctrine of consubstantiation, or what was afterwards described by the still more barbarous term of impanation. It was the age of minute and evanescent distinctions, and of scholastic refinement; a taste for subtle discrimination among kindred or similar ideas prevailed; and neither arguments nor illustrations were wanting. "As in red hot iron," said Luther, "two distinct substances, viz. iron and fire, are united, so is the body of Christ joined with the bread in the eucharist." To such an argument or illustration, if it deserve the name of either, was a man even of Luther's sagacity reduced, when he set himself to maintain, what he felt to be absurd. But while the Saxon reformer was zealously employed in maintaining the incomprehensible tenet of consubstantiation, a more plain and accessible doctrine was proposed by Zwinglius, his cotemporary. We have already mentioned the name of this distinguished person, as the first reformer of Switzerland; and have stated, that he commenced his career with an activity equal or superior to that of Luther himself. Zwinglius rejected at once both the doctrine of the Romish church, respecting the eucharist, and the notion of consubstantiation, maintaining, certainly with a
greater appearance of reason, "that the body and blood of Christ were not really present in the eucharist; and
that the bread and wine were no more than external
signs or symbols, intended to excite in the minds of
Christians the remembrance of the sufferings and death
of the divine Saviour, and of the benefits which result
from his heavenly intercession." Besides the names of
Luther and Zuinglius, as leaders in this mysterious con-
troversy, we must not fail to mention that of the cele-
brated Calvin. This last reformer was not a whit be-
hind the greatest of his contemporaries in activity and
zeal. He maintained, however, a doctrine apparently
intermediate between that of Luther and the opinion of
Zuinglius; though it is not to be denied, that, upon
this subject, he expressed himself with such an extra-
ordinary diversity, and even ambiguity of phrase, as
renders it difficult or impossible to ascertain what his
real sentiments were. Upon the whole, the opinion of
Calvin seems to have been, that Christ was "spiritually
present" in the eucharist; or, in other words, that as
our blessed Saviour, according to the promise which
he made to his disciples, is present with them, when-
ever two or three of them are met together, so he is
more immediately and effectually present, when they
approach him in the solemn service of the Supper.

About the middle and towards the close of the six-
teneth century, the heresy of the Socinians began to
appear in different parts of Europe, and especially in
Poland. This heresy derives its name from its chief
patrons, Lachius and Faustum Socinus; the former, a
man of considerable learning as well as acuteness; the
latter, distinguished by his resolution and his prudence.
The heresy in question may be regarded as an exten-
sion of the Arian doctrine, respecting the nature and the
person of Christ, his inherent dignity, and the wor-
ship which is paid to him. Arian, indeed, went no fur-
ther than maintaining, that there was a time hid in the
depths of eternity, when the Son of God did not exist;
Socinus and his followers contended, that he had no ex-
istence at all, previous to his miraculous conception in the
womb of the virgin. Arian regarded our Saviour as the creator of the visible world; Socinus acknow-
ledged him only as a messenger from heaven, and a true prophet. In a word, the Polish sectaries main-
tained, that Christ, in his nature or essence, was a
man, and nothing more, (φυσις ανθρωπως); but, with a
strange inconsistency, they allowed that he was pro-
duced by extraordinary and heavenly generation; and
that it was incumbent on all Christians to address him
as an object of worship. They denied the pious in-
spiration of the sacred books, and rejected the person-
ality of the Holy Ghost. The tenets of the Socinians
are fully set forth in the Raccoian catechism; and their
interpretations of Scripture are to be found at large in the
complete collection of their writings, entitled the
Bibliotheca Fratrum Polonorum. "The ancient cate-
chism," says Mosheim, "which was no more than a
rude and incoherent sketch, was laid aside, and a new
form of doctrine was drawn up by Socinus himself.
This form was corrected by some, augmented by others,
and revised by all the Socinian doctors of any note;
and, having thus acquired a competent degree of accu-
racv and perfection, was published under the title of the
"Catechism of Racow," and is still considered as
the Confession of Faith of the whole sect.

In later times, a certain modification of the Socini-
an doctrine was proposed by Dr. Priestley, and repre-
sented, in his numerous writings, as the only doctrine
contained in the sacred books. More daring than the
first patrons of the cause, the modern heresiarch de-
clares that Jesus Christ is a man in every sense of the
word, born of Joseph and Mary, in the way of ordi-
nary generation; that he was put to death, as some of
the apostles and early Christians were, in consequence
of the hatred and power of his enemies; and that he is
to be distinguished from the primitive preachers of
our religion, only by the circumstances of rising
from the dead, and of presiding at the general judg-
ment. Dr. Priestley likewise contended, and with per-
fected consistency, that every act of worship addressed
to Jesus is an act of idolatry; disregarding, as it ap-
pears, the prayer of the holy martyr Stephen, when
expiring under the fury of his persecutors. In con-
junction with their predecessors, the patrons of the
new doctrine deny the pious inspiration of the sac-
red writings; find out, with a discernment not very
easily communicated to their disciples, what passages
we are to reject, and what portions we are bound to re-
ceive; and even venture to affirm, without awe or con-
cern, that they have detected the great apostle of the
Gentiles "in reasoning inconclusively." The modern
system, too, is coupled with certain philosophical and
recondite speculations, about the materiality of the hu-
mansoul, and the necessity of moral actions; and,
when its parts are taken together, or put into juxtapo-
sition, it forms, beyond all question, the most extra-
ordinary phenomenon which the theology of the eight-
teneth century can produce. The antagonists of Dr.
Priestley, were, Dr. Price, in the philosophical depart-
ment, and Dr. Horsley, bishop of St Asaph, in the
critical and historical; and the latter, in particular, is
understood to have established the primitive or Niece
faith, with singular and tremendous ability, and
with triumphant success.

The third and last heresy which we shall mention, is
that which derives its name from Arminius. It is mere-
ly a less repulsive form of the doctrine proposed in the
fifth century by Pelagius, a man once famous in the
estimation of the learned, but now so far moved from
his place, and clouded in the lustre of his reputation,
that no country of Europe contends with our native
island, for the honour of his birth. He is the father of
the sect denominated Pelagians. Arminius, whom we
have just mentioned as adopting, with some variety,
the tenets of this sect, was a disciple of Beza, and
professor of divinity at Leyden. In a controversial
point of view, he is to be considered as the antagonist
of Calvin; and he is justly recorded as the first who
attacked the theology of Geneva with any measure
of success. The tenets of Arminius were solemnly con-
demned in a synod, which met at Dort in the
year 1618. They are usually called the "five Armi-
ний points;" and the doctrine contained in them is
expressed in the following propositions. The Armi-
nian sectaries hold. 1. That God, from all eternity,
has determined to bestow salvation on those only, with
regard to whom he has foreseen, that they will persevere
unto the end in their faith in Christ Jesus; and to in-
fect everlasting punishments upon those who shall con-
tinue in their unbelief, and resist unto the end his di-
vine succours; so that election is conditional, and re-
probation, in like manner, the result of foreseen infide-
licity and persevering wickedness. 2. That Jesus Christ,
by his sufferings and death, has made an atonement for
the sins of all mankind in general, and of every individ-
ual in particular: but that none, excepting those who
believe in him, can be partakers of this divine benefic.
3. That true faith cannot proceed from the exercise of

Arminian.
our natural faculties and powers, nor from the force and operation of free will; since man, in consequence of his natural conception, is incapable either of thinking or of doing any good thing; and that therefore it is necessary to his conversion and salvation, that he be regenerated and renewed by the operation of the Holy Ghost, which is the gift of God, through Jesus Christ.

4. That this divine grace, or energy of the Holy Ghost, which heals the disorder of our corrupted nature, begins, advances, and brings to perfection, every thing that can be called good in man; and that, consequently, all good works, without exception, are to be attributed to God alone, and to the operation of his grace: that, nevertheless, this grace does not force the man to act against his inclination, but may be resisted and rendered ineffectual, by the perverse will of the impenitent sinner.

5. That they who are united to Christ by faith are furnished with abundant strength, and with success sufficient to enable them to triumph over the seductions of Satan and the allurements of the world; but that the question, "Whether such may fall from their faith, and forfeit finally this state of grace?" has not yet been resolved with sufficient perspicuity; and must therefore be yet more carefully examined by an attentive study of what the holy scriptures have declared, in relation to this important point. This is the fifth article as it was originally propounded by Simon Episcopius and the other Arminians in the Synod of Dort. "It is to be observed, however," says Mosheim with regard to this article, "that it was afterwards changed by the Arminians, who in process of time declared their sentiments with less caution, and positively affirmed, that the saints might fall away from a state of grace. For a full account of the Arminian controversy, the reader may consult the works of Arminius himself, together with those of Episcopius and Grotius, Brandt's History of the Reformation in the United Provinces, vol. ii. and iii.; Whitley's Treatise on the Five Arminian Points; and a work of great pretensions, lately set forth by Dr Tomline, Bishop of Lincoln. On the other hand, may consult the volumes of Calvin and Gill, and a very profound and masterly Treatise on Free-will, by the celebrated Dr Jonathan Edwards of America.

Conclusion.

In a work like the present, the article Ecclesiastical History must, of course, be a very general one. Having, therefore, now given a short account of the most important controversies which have been agitated among the Protestants since the time of Luther to the present day, we shall bring our labours to a close. And in looking around us, we cannot contemplate the existing state of Christianity without the sincerest emotions of gratitude and joy. Not many years ago, the security of our holy religion was shaken by the torrent of infidelity, which threatened to overspread, with its mighty force, every country of Christendom. The fanaticism which prevailed, had its origin in France. In this unhappy kingdom, the superstitions of Rome had been so confounded with genuine Christianity, that they were completely identified in the estimation of the people. An erring philosophy, that failed to distinguish between things unquestionably different, had gained possession of the public mind; the chief authority was put into the hands of the multitude, ever captivated with the novelty and the acquisition of power, and ever ready to abuse it; the whole system of Christianity was ferociously overthrown; the observance of the Sabbath was abolished:—the human understanding seemed to be perverted beyond the hope or the possibility of recovery, and the human character, as exemplified among the revolutionists of France, appeared to become every day, more and more degraded and brutal. The convulsions of the state kept pace with the downfall of the church. The madness heightened, and was exasperated; the hearts of men, who looked on and witnessed the scene, failed them through fear: other nations felt the shock of dissolving empire, or were engulfed in its ruins. But better days have at length arrived. The contending elements have found their balance and their proper place. We rejoice in the cessation of a protracted warfare, and would record in our pages too, and with no little or feigned satisfaction, that the captains and the mighty men have met together, each of them with "the green branch" in his hand. A reputable, and, as we trust, a permanent peace has at last been attained. But we know not ourselves at all, if this be the only cause of our joy. The human mind has returned to a sense of religion, and the acknowledgment of a God. The throne of the Redeemer has again been erected. From England a light is gone forth which shall illuminate the most distant lands. Christian benevolence has multiplied her children. A society has been formed and established for the printing and the circulation of the holy scriptures; differences are laid aside, dissensions are forgotten; the lofty churchman unites with the humble Presbyterian, or still humberl Methodist; one feeling bounds in every breast, and every prayer which is breathed to heaven is breathed for the accomplishment of the prophecy, which assures us, "that the knowledge of the Lord shall cover the earth as the waters cover the sea." In point of fact, this prophecy, through the exertions of the British and Foreign Bible Society, has already, in part, been fulfilled: and it is now true with a peculiar significance in the statement, and extent in the application of the language, "that the heathen is given" to Christ Jesus "for his inheritance, and the uttermost parts of the earth for a possession." See Mosheim's Ecclesiastical History, passim; Lardner's Works, passim; Du Pin's Church History; Campbell's Lectures on Ecclesiastical History; Histoire Ecclesiastique par Fléury, edit. Bruxelle; Father Paul Sam's History of the Council of Trent, translated from the Italian into French by De la Houssaye; Jortin's Remarks on Ecclesiastical History; Neal's History of the Puritans; M'Crie's Life of John Knox; and Reports of the British and Foreign Bible Society, passim. (ck)

ECHINUS. See MOLLUSCA.

ECHO, from the Greek word σφων, a sound. In the article Acoustics, we have already treated the subject of echoes, as connected with the general doctrines of sound, having reserved for the present article, brief notices of some of the most celebrated echoes.

Dr Plot, in his Natural History of Oxfordshire, mentions an echo in Woodstock Park, in Oxfordshire, which repeats 17 syllables in the day-time, and 20 in the night. This effect he ascribes to the superior density of the air during the night, which diminishes the velocity of the sound.

Harris describes an echo on the north side of Shipley church, in Sussex, as repeating 21 syllables distinctly, under favourable circumstances.

Dr Birch informs us, that there was an echo at Rosebank, in Argyllshire, in Scotland, which distinctly repeated, three times, a tune played on a trumpet. When a person, placed at a proper distance, plays eight or ten notes, they are correctly repeated, but a third lower; after a short silence, another repetition is heard, in a still lower tone; and, after another short interval, there is a third repetition, in a still lower tone.
Addison describes an echo at the palace of Simonetta, near Milan, as returning the sound of a pistol 56 times. The palace has two wings; and, when a pistol is fired from a window in one of the wings, the sound is reflected from a dead wall in the other wing, and is heard from a window in the back front. The following account of it, however, from Keysler, is more minute and interesting.

"At the Marquis Simonetta's villa is a very extraordinary echo; it is occasioned by the reflection of the voice between the opposite parallel wings of the building, which are fifty-eight common places from each other, and without any windows or doors, by which the sound might be dissipated or lost. The repetition of the sound dwells chiefly on the last syllable, which might have been altered by allowing a greater distance between the two wings; but possibly it was apprehended, that the number of the repetitions would be diminished by that means. Two or more bodies placed opposite each other, at different distances, are requisite to form a multiplied echo; or the wall at which the speaker stands, must have another wall opposite to it, so as to form two parallel planes, which will alternately reflect to each other the sound communicated to them, with as little dissipation as possible. This last circumstance is found in the two parallel wings of this seat, which, forming right angles with the main body of the building, have a very surprising effect. A man's voice is repeated above forty times, and the report of a pistol above sixty, by this echo: but the repetition is so quick, that it is difficult to tell them, or even to mark them down, unless it be early in the morning, or in a calm still evening: when the air is rather too moist or too dry, the effect is found not to answer so well."

Southwell mentions a building, similar to the palace of Simonetta, which had projecting wings, and produced 60 repetitions of every sound.

The Abbé Guynet describes an echo on the road from Rochepot to Chalons, which repeats, in the day-time, 14 syllables well articulated, and, during the night, 16 syllables.

About three leagues from Verdun, there is a singular echo, occasioned by two towers projecting from the body of a house, and distant 26 toises, or about 50 metres. When a person stands in the line between the two towers, and pronounces a word in a pretty high tone, he will hear it repeated 12 or 13 times at equal intervals, and always more feebly. If he places himself at a certain distance out of this line, the echo is no longer heard. One of these towers has a low apartment vaulted with hewn stone, while the other has its vestibule vaulted. See Hist. Acad. Par. 1710.

In the Memoirs of the French Academy of Sciences for 1792, there is described a curious echo, at Genefay; in the neighbourhood of Rouen. A person who sings, does not hear the repetition of the echo, but merely his own voice; whilst those who listen hear only the repetition of the echo, though with singular variations. Sometimes the echo seems to approach, and at other times to recede. One person hears a single voice, and another several voices: one person hears the echo on the right, and another on the left; the echo always varying with the position of the person who hears it.

M. Quesset has described another singular echo near Rouen, in the Memoirs of the Academy for 1664.

In the neighbourhood of Coblenz, on the banks of the Rhine, there is a very remarkable echo, which is described by Barthius, in his notes upon the Thebaid of Statius. He has heard it repeat words seventeen times, and it produces exactly the same effects as that at Genefay, near Rouen.

At Lochielair, a lake in Inverness-shire, and the property of J. P. Grant, Esq. of Ruthemuckethrach, there is a very fine echo. The wall of an old castle, in the middle of the lake, repeats several syllables with great distinctness; and when a pistol is fired, the sound is repeated about thirty times, from the numerous and lofty hills with which the lake is circled.

In the neighbourhood of Edinburgh, in the King's Park, there is a place called the Echoing Rock. A person standing in front of this, will hear repeated with great distinctness several syllables which he may utter. The sound is in this case reflected from a circular wall at a great distance, and the rock to which the property is ascribed merely happens to be near the centre of the circular wall.

In erecting the baptistery of the church of Pisa, the architect, Giovanni Pisano, disposed the concavity of the cupula in such a manner, that any noise from below is followed with a very loud and long double echo. The repetition, however, is not so distinct as that of Simonetta. Two persons whispering, and standing opposite to each other, with their faces near the wall, can converse together without being overheard by the company between. This arises from the elliptical form of the cupula, each person being placed in the focus of the ellipse.

In the cathedral church of Gloucester, there is a whispering gallery above the eastern extremity of the choir, and which extends from one end of the church to the other. If two persons, placed at the distance of 22 toises, speak to one another in the lowest voice, it is distinctly heard. A similar effect is produced in the vestibule of the Observatory of Paris, and in the cupola of St Paul's in London. Mr Southwell informs us, that, in Italy, on the way to Naples, and two days journey from Rome, he saw in an inn, a square vault, where a whisper could easily be heard at the opposite corner; but not at all on the side corner that was near to you. This property was common to each corner of the room. He saw another on the way from Paris to Lyons, in the porch of a common inn, which had a round vault. When any person held his mouth to the side of the wall, several persons could hear his whisper on the opposite side.


ECLECTICS, a name given to certain ancient philosophers, who endeavoured to form a system of opinions by selecting from every sect those doctrines which seemed to approach nearest to the truth. Hence their denomination, derived from 

"Echo," as "I choose," may be considered as referring either to themselves or their tenets; and may signify either "one that chooses," or "that which may be chosen." They were also denominised "philologici," but generally called themselves "philosophers," i.e. "lovers of truth," or rather never assumed any distinct name, but wished to be considered as chiefy followers of Plato, whose philosophy they made the foundation of their system. The notion of such a philosophical selection had been adopted by several of the leaders among the Grecian sects, even by Plato, Zeno, and Aristotle; had been sufficiently con-
mon among the Alexandrian philosophers, from the commencement of their schools, had particularly prevailed, (as appears from Philo, who was himself an eclectic,) about the beginning of the Christian era; and was followed, in a later period, by Plutarch, Pliny, Galen, and many others. Between the endless contests of the dogmatists, and the dark uncertainty of the sceptics, it was by no means an irrational scheme to separate from every former system its purest and best supported tenets, and to form them into a new institute of philosophical and religious truth. The idea was peculiarly acceptable to those Heathen philosophers, who felt the growing ascendency of Christianity; and who endeavoured to support the declining influence of their own schools, by incorporating Christian principles into their new system. The first, however, who attempted to establish a distinct sect upon this scheme, appears to have been Ptolemaeus of Alexandria, who is supposed by some to have flourished during the reigns of Augustus and Tiberius; but, according to others, about the close of the second century. Nothing more is known of his system, but that he endeavoured to reconcile the tenets of Plato with those of other philosophers; and it is generally concluded, that his attempt to found a school upon the eclectic principle proved unsuccessful. The eclectic philosophy received its proper form and establishment from Ammonius, another philosopher of Alexandria, who flourished about the beginning of the third century, and who, from his former profession of a porter, (εστρωτης) was surnamed Sacca. (See Ammonius.) This philosopher, however, and his followers, ought properly to be considered, like their precursor Ptolemaeus, as merely modern Platonists; and there is a gross impropriety in giving them the name of eclectics. Instead of selecting a little from each, he professed to unite all sects in one. He maintained, that the great principles of philosophic and religious truth were to be found equally in all the different systems; that they differed from each other only in their method of expressing their tenets, except a few points of minor importance; and that, by a proper interpretation of their respective sentiments, they might easily be united into one body. He considered the ancient philosophy of the East, preserved in his opinion uncorrupted by Plato, as the primitive standard, and actual substance, of all the religious systems in the world; and affirmed, that to remove the errors which in all nations had been more or less blended with this ancient theology, and thus to restore them to their original purity, was the great design of Jesus Christ in descending upon earth. Upon this principle, as all the sects were fundamentally right, there was no occasion to select any thing from each; and it was even of little consequence which of them was chosen, as the enquirer, by merely removing the supervening errors, was sure to find in any one of them the true doctrine at the bottom. As Ammonius left no writings of his own, and as he taught his more sublime mysteries only to a few select disciples, under a solemn injunction of secrecy, it is scarcely possible to ascertain what he considered as the original and uncorrupted system of truth; and though several of his followers afterwards divulged the secrets of his school, their expositions are so full of obscurity, and so mixed with dogmas of their own, that the real system of their founder cannot be separated with any degree of certainty from so confused a mass. The leading object of the whole was to obstruct the progress of the Christian religion, by forming such a combination of the principal tenets of the Heathen and Christian schools, as might confirm the former in their attachment to the old superstitions, and reconcile the latter to the doctrines of Paganism. Hence, on the one hand, they represented Jesus Christ as the friend of God, who came not to abolish, but to purify the ancient religions; incorporated into their system many of the peculiar doctrines of revelation, and even adopted, on many occasions, the language of the Christian Fathers. On the other hand, they endeavoured to conceal the absurdities of Paganism under the veil of allegory; and represented the numerous train of Heathen divinities, as celestial ministers emanating from the Supreme Deity, who was himself worshipped in the adoration which they received. The philosophy of Plato, already united with that of Pythagoras, formed the basis of the new system; and with these doctrines they attempted to blend those of Aristotle, of the Stoics, and of almost every system except that of Epicurus, whose mechanical principles of nature could never be made to coalesce with the doctrines of Platonism. Not satisfied with the intuitive contemplation of intelligibles, and especially of the first intelligence, which Plato posited as the summit of human felicity, they aspired after a sort of deification of the human mind; adopted from the Oriental philosophy the system of emanation, one of an indefinite series of spiritual natures derived from the supreme source; and, besides supposing, that the soul of man, by various stages of purification, might at length reach a mysterious union with the divine nature, they conceived, that, even in this life, it might be prepared, by previous discipline, to enjoy, in ecstasy, an intuitive vision of the Deity. Upon such fanciful foundations, they constructed systems of metaphysics, morals, and theology, of which it is impossible to convey any intelligible idea, and which indeed seem never to have been properly fixed or defined in the minds of their authors. Their great principle, also, of producing an apparent harmony among systems essentially different, necessarily compelled them to have recourse to vague expressions, fanciful interpretations, and subtle distinctions, till they at length involved themselves and their readers in endless subtleties and impenetrable obscurity.

After the death of Ammonius, the system was completed by his disciple and successor Plotinus; taught also by Porphyry, and Jamblichus; adopted by Longinus, Eustathius, Julian the apostate, Hecules, Chrysanthus, &c. In the reign of Julian, it was publicly professed at Athens, and, by the emperor's appointment, was taught there by Chrysanthus last mentioned, who was succeeded by Plutarch the son of Nestorius, Syrian, Proclus, Marinus, Isidorus, Zenodotus, &c. It was supported by the celebrated Hypatia, Macrobius, Ammonius Marcellinus, &c, but expired among the Pagans in the 7th century. It received, even from its commencement, the approbation of many eminent teachers among the Christians, especially Athenagoras, Panteus, and Clemens Alexandrinus; and became, through many succeeding ages, a fruitful source of confusion and corruption in the church of Christ. But, in the course of the 17th century, arose the true eclectic philosophy, which admits of no sectarian subdivisions, rejects prejudices of every description, renounces all submission to celebrated names or ancient sects, subjects the opinions of all former philosophers to the strict scrutiny of reason, and admits no conclusions but what may be clearly deduced from principles founded on the nature of things, or discovered by actual experience. Of this method, the principal promoters were Bacon, De Cartes, Leibnitz, Malebranche, Locke, Grotius, Selden, Pufendorf, Copernicus, Kepler, Galileo, Boyle,
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The Eddystone rocks consist of three principal ridges, which have been distinguished by the relative names of House Reef, South Reef, and East Reef. These rocks, in their greatest extent, lie north and south, and in this direction measure about 600 or 700 feet in length; besides a small rock, seen only in spring tides, called the north east rock, which lies about one thousand feet from the house rock. From the general aspect and appearance of the Eddystone rocks, there is reason to infer that the whole consists of the same kind of stone. The state of the weather did not admit of the writer of this article touching at any of the rocks excepting that on which the lighthouse is built, which he the more regrets, as, from the smallness of the house rock, it would be a kind of sacrilege to mutilate it by breaking off specimens, so that he was left to judge imperfectly of its composition from parts which were worn by the feet of the light keepers. It seems to be either granite or gneiss, called moulstone in Cornwall. The felspar is most abundant in it, and is chiefly of a brownish colour, containing large irregularly shaped white specks. It dips in generally at the rate of one perpendicular to two horizontal, is extremely hard, and has a very rugged appearance. Its greatest horizontal dimensions at low water is about 65 feet, and its least about 35 feet. On the eastern side it is perpendicular to the surface of the water, and at one place may be said rather to over-hang, where the top of the rock is elevated about 18 feet above low water mark of spring tides, and is therefore seldom covered by the rise of the tide, but on the western side it slopes towards low water mark. The lighthouse is of difficult access on all sides, and can only be approached in moderate weather. The gut, or landing place, is formed by the house reef, and the south reef, which afford some shelter for a boat at low water. In this gut there is about one fathom of water at the lowest tides, but in all directions from the rocks the water suddenly deepens to 15 and 20 fathoms, and at greater distances to 45 and 50 fathoms.

On the days of new and full moon, it is high water at the Eddystone at a quarter past five o'clock. The tide of flood sets easterly, or up Channel, and the ebb tide sets westerly. Spring tides rise from 16 to 18 feet, and neap tides from 10 to 11 feet; but in storms, the sea at this place flies to an incredible height. At these rocks, and upon the opposite shores, it is high water about two hours and a half sooner than in the middle of the channel.

The nature of the stone, and the small dimensions of the house rock, are adverse to the growth of marine fungi, or to the habitation of animals. Of the former, only the smaller sorts of sea-weed were observed, as fucus mamilla-losus, fucus palmatus, the common dulse, and conof-a rupestris, which, in continued storms, appears to acquire a growth upon the western side of the lighthouse, about 20 feet upon the building. The only shell-fish seem to be the lepas balanoides, or barnacle, and a few limpets of a small size: these last might perhaps increase both in number and in bulk, were they not apt to be destroyed for bait before they are matured in growth. In very moderate weather, a few young coal fish are caught by the light keepers, and, in the vicinity of the rock, the fish common upon the coasts of Cornwall and Devonshire, are caught in abundance, as hake, John Dorie, cod, conger, cef, dog-fish, haddock, whiting, skate, turbot, holibut, flounder, sole, mackerel, herring, and pilchard. (s)

EDGAR. See ENGLAND.
EDINBURGH.

EDINBURGH, the metropolis of Scotland, is situated in the northern part of the county of the same name, or Mid-Lothian. The centre of the city lies in 55° 57' 58" north latitude, 8° 11' 55" west longitude, and is about two miles from the estuary called the Firth of Forth, where, in Leith harbour, the tide rises nearly 16 feet. But intermediate buildings, which are rapidly increasing, will soon identify Edinburgh with the town of Leith; and, in general calculations, they are even now included together. The following observations, however, are restricted to the former.

The length of Edinburgh, from east to west, is between a mile and a half and two miles; the breadth is about the same; and the circuit is calculated at eight miles. Its general site may be described as on elevations; the centre of the city standing on a high narrow ridge, declining towards the east, from a lofty precipitous rock, on each side of which are two valleys, one entirely occupied by buildings, the other partly so, and chiefly consisting of a marsh, nearly dry in summer. This marsh, which is 200 feet below the top of the rock, is crossed by a bridge 1270 feet long, of five arches; by an immense earthen mound of great breadth and depth; and also by an intermediate mound of smaller dimensions, all to the north. The buildings to the south of the city, independently of other communications, are connected by another bridge of 22 arches, one with more level ground, on which the city is extended. Only one of these arches, 30 feet wide, is visible; the rest being fronted by houses, of which they form a part. The span of the larger arches of the first, or North Bridge, is 72 feet, and the height to the top of the parapet 68; but the arches and piers occupy only 310 feet of the whole 1270, which partly form a street. From thence, the city, to the north, occupies a slight elevation, which soon becomes a gradual declivity down to the sea. Edinburgh is thus divided, by the North Bridge and Earthen Mounds, into two parts, known by the distinguishing apppellations of the Old and New Town: the former has been built from all different periods down to the present day, with little order or regularity; but the latter, being altogether of modern erection, and formed after a certain determinate plan, exhibits an elegant assemblage of edifices, disposed in ample streets and spacious squares. This portion of the city is the residence of the better class of inhabitants, though not exclusively; for some part of the old town, to the south, also consists of modern buildings, equally commodious.

The two principal streets in the Old Town intersect each other at right angles: first, the High Street, which stretches from the castle to the abbey, 5570 feet, under different names; and, secondly, a street, commencing at the Register Office, and terminating in St Patrick's Square, after also passing by different names, of nearly the same extent. From the High Street, which occupies the elevated ridge, numerous lanes diverge on either side down the declivity; and some are so steep as to require steps for the security of passengers. There are three principal streets in the New Town: Prince's Street, George's Street, and Queen's Street uniting with York Place. The first is 4110 feet long by 100 broad; the second 2640 by 115; and the third, 4440 by 100. These principal streets, and others which, now in progress, will soon merit the same denomination, are intersected at right angles in several places, by wide cross streets. George's Street terminates in a square at either extremity; and there are on each side two subordinate parallel streets, Rose Street and Thistle Street, 30 feet in width, and extending half a mile.

There are few squares in this city, considering its magnitude; and of these, the principal are, George's Square, in the Old Town, which measures 665 feet by 510; and St Andrew's and Charlotte Square in the New Town. There are several, however, such as St James's, St Patrick's, and Nicholson's square, of smaller dimensions; but the inequality of the ground, the width of the streets, and the salubrity of the atmosphere, render the want of squares a less sensible defect. From many points of the city, the most varied and delightful prospect is commanded, either in ranges of hills, distant mountains, or verdant fields, bounded by a beautiful river, which is traversed by numerous vessels.

Almost the whole city is built of fair hewn stone, buildings from inexhaustible quarries in the neighbourhood; and the houses are covered with slates. The New Town is invariably so; and the front of all the buildings in the principal and cross streets are fenced with neat iron railing. Here they are less commodious than the exterior would indicate; but the high price of ground-rent obliges the architect to seek that accommodation in altitude which would be more conveniently disposed in surface. Thus two stories are sometimes sunk below the level of the street. Ground-rents are in many places L. 10, L. 20, or even nearly L. 30, for the site of the house and a small plot behind it; and the price of the best houses is L. 2000, L. 3000, or L. 4000. The yearly rent of such is from L. 100 to L. 160, or more. In the Old Town, on the other hand, the houses being for the most part crowded together, their inhabitants are deprived of many conveniences found in more modern edifices. Frequently they rise to a great height, being five, six, or seven stories from the street; and there are even instances of some houses consisting, on one side, of eleven or fourteen stories, each of which is inhabited by a different family. But this uncommon structure is owing to the sudden declivity of the bank on which they are founded.

Edinburgh is a remarkably beautiful city, not only from its situation, but from the width of the streets, particularly of the modern part, the regularity of architecture, and the colour of the stone employed in the buildings. Nor is its general appearance less singular, from lofty edifices on a high ridge, overlooking those which occupy the lower grounds; from the two bridges, without water to either; and the immense mound connecting the different divisions of the city. The magnitude of this may truly be the subject of admiration, especially considering the few years in which it has been produced. The Earthen Mound is 960 feet in length, 188 feet broad at the first opening to the north in the wall traversing it; and, at the same place, about 100 in perpendicular height, but somewhat more at the opposite extremity. It is composed almost entirely of the rubbish excavated from the foundation of the houses.
in the New Town, since the year 1783. An enormous quantity of earth has sunk into the marsh below, and the whole is still yielding, from the accumulated pressure.

The most striking object, on approaching this city, is the Castle, perched on a lofty isolated rock, elevated on three sides from a level plain. Part of it, especially on the north, is absolutely perpendicular, or somewhat overhanging the base, to the height of 150 or 200 feet; but to render the rest still more inaccessible, we read, that the governor who held it for the adherents of Mary, took pains to "pare away the green grass" that had taken a slender root in the fissures of the rock. Of old, the castle was certainly a place of great strength, and it has stood many tedious sieges; but, being commanded by ground within the range of artillery, its importance in modern warfare is much diminished. Etymologists have found equal difficulty in the derivation of Castrum Alatum, the Maiden Castle, or Edinburgh; but it seems more generally admitted to have been from Edwin, the Northumbrian potentate, in the seventh century; and that the town, gradually seeking protection under its walls, thence received the name of Edwinesburg, by which it was anciently known. The castle is now separated from the city by a vacant regular acclivity, 350 feet long, and nearly as broad, which has lately been supported by a strong wall, sunk several feet below the level. Its entrance is by a draw-bridge, which is raised every night, over a wide dry ditch, and guarded by strong palisades without, where the heaviest ordinance on the batteries may be pointed. Different gates within open into a winding way, which ascends to various edifices, for stores, barracks, or other purposes; and the grooves, from which two portcullises descended, still denote the obstacles opposed to an assailing enemy. The surface of the rock, extending to six or seven acres, is disposed in batteries, or for the accommodation of troops, and what is requisite for a garrison; and the highest part, up long flights of stairs, consists of a square, which is used as a parade. A circular draw-well is on the higher part of the castle, but as the water recedes with the firing of cannon, it becomes a precarious resource: and there are instances of the besieged being obliged to resort to a well without the ramparts, which, on one occasion, an enemy poisoned, and thus forced them to surrender. To supply this defect, a capacious cistern has been erected, which is filled by pipes brought into the castle from a reservoir at a distance. There are numerous cannon on the walls, whose signals have long been devoted to festivities only; and there is a small armoury, which, when full, can contain 30,000 stand of arms. It is said that 3000 men can be accommodated in the castle: Part of the barracks are of recent erection, and by an injudicious and inconsistent style of architecture, have materially impaired the grand and imposing aspect which this fortress presented. King James the Sixth of Scotland, under whom the island of Britain became one empire, was born here in a small square apartment in the south-east part of the castle. The date of his birth is painted on the wall, also the royal arms of Scotland in good preservation, and some indifferent verses written under them. In a late examination, no date older than 1565 could any where be observed. At the time of the Union, the Scotch regalia were deposited with much solemnity in a room with strong grated windows; and the door, which enters from a stair-case, is also strongly secured, though not built up. Whether they still remain is uncertain; but most probably prudential reasons have long ago led to their destruction or removal. They were too dangerous insignia of royalty to lie within the reach of the dissatisfied during the rebellions of the preceding century. Towards its close, however, a vague report having arisen, that some of the records of the kingdom were contained in the same room, a warrant to search it was issued from the office of the secretary of state, addressed to several individuals holding high official situations here. Nothing was found but an old chest covered with dust; and doubts being started by one of the deputation, whether the words of the warrant contained authority to go farther than simple inspection of the room, the search was abandoned, and an opportunity of ascertaining the fact, not likely to recur, was lost.

The history of the castle of Edinburgh would be an abbreviated history of the kingdom. Contending factions anxiously sought possession of it, and its fall was usually followed by that of the metropolis. Of old it was a royal residence, more particularly in those unsettled periods, when strength constituted the chief security of individuals.

The Abbey of Holyrood, however, at the opposite extremity of the city, was the principal abode of the kings of Scotland for several centuries preceding the union of the crowns; even during the rebellion, it was occupied by the last descendant of the Stuarts; but it has never been visited by any sovereign of the house of Hanover. This abbey was originally founded in 1128 by David I. in commemoration of his escape from danger, while hunting in the neighbouring forests, and endowed with ample revenues. But we know that he dwelt in the castle, and that it was not until the time of his successor James V. in the sixteenth century, that adjoining buildings rendered it a royal palace. Only the walls of the abbey remain: the eastern window, which was an elegant remnant of Gothic architecture, yielded to an extraordinary tempest in the year 1795. The remainder has long been in a state of progressive decay. James VI. is said to have repaired and embellished the church, at the same time providing it with an organ, a throne for the sovereign, and twelve stalls for the knights of the thistle. But the mob, in abhorrence of popery, immediately afterwards broke in, and, in the fervour of their zeal, committed greater devastation than was wont to be done by a public enemy. Their ravages being repaired at a considerable interval, a new roof of ponderous flag-stones was raised upon the walls, which speedily appeared very insufficient to bear it. The impending danger was communicated to the Barons of Exchequer, but no measures having been taken to prevent it, the roof fell in during the year 1768, since which time the abbey itself has been a total ruin. It was the royal cemetery of old, and also a place of sepulture for distinguished persons. James V., his queen, and several of their children and successors, were entombed here. A vault, containing the body of the king, was visited by some curious and intelligent persons, in the year 1688, when they found it coloured black, from the balsam in the coffin resembling melted pitch. He died in the year 1542, but hair still seemed to be on the head. There was also a coffin containing the body of Queen Margaret, who died immediately on landing in Scotland in 1537. That of James was in wood, encircled by another coffin of lead. But when the roof fell in 1768, the sepulchres were violated, and the chapel again ransacked by the mob. Arnot in his History relates, that between the years 1776 and 1779, the leaden coffin of James V. and some others, were stra-
The head of Queen Magdalen, which was then entire, and even beautiful, and the skull of Darnley, were also stolen. Several bones of enormous size, reputed to be those of this nobleman, the husband of Mary, were lately exhibited, as also a body called that of a Countess of Roxburgh, converted to a mummy. The entrance to the vault containing these relics, was built up within these few years, so that the dead can be disturbed no longer. Most of the area of the church is now covered with rubbish; but on examining parts of the pavement, figured stones, with inscriptions of considerable antiquity, may be discovered. It is still used, though on rare occasions, for the sepultures of different families and their connections. On the exterior, two coats armorial with supporters of great antiquity, are visible, though much defaced by time.

The palace itself is a large quadrangular edifice of hewn stone, with a court within, surrounded by a piazza. The west front, which extends 230 feet in length, consists of two lofty double circular towers at each angle, connected by a lower building, ornamented above by a double balustrade; and in the centre is a porch, which is the principal entrance, with stone columns, "supporting a cupola in form of an imperial crown." Above the entrance are the arms of Scotland, as borne previous to the Union; and within are the same arms as borne after it. A small garden is before the east front, which is of modern architecture.

In this palace, there is a gallery 150 feet long, by 27½ wide, and 18 feet high, containing portraits of all the Scottish kings, from the reputed time of Fergus. But few or none are genuine, although some may be copies of originals; and we are told that a Dutch artist, named De Witt, was employed to make the collection. A great desire that the nation should remount to extraordinary antiquity, has always prevailed in Scotland; and it appears that, amidst the pageantry exhibited to Charles I. by the University of Edinburgh in 1633, at his public entry, there were portraits of 109 kings in Scotland: the number in Holyroodhouse is said to be only 111. Mercury was there represented bringing up Fergus I. in suitable attire, "who delivered to his Majesty a very grave speech, containing many precious advices to his royal successor." This gallery is now used at the election of the sixteen peers of Scotland to represent their order in Parliament; and during the residence of the princes of the house of Bourbon and the French noblesse, mass was sometimes performed in it. There are some other pictures in the palace, particularly one of Charles I. and his Queen, and several old portraits. The bed-chamber occupied by the unfortunate Mary, with her own bed, now advancing to decay, are still to be seen; also a cabinet where her secretary, David Rizzio, was seized in her presence, dragged forth, and assassinated. The credulous are taught to believe that his blood yet stains the floor of the adjoining apartment.

The Duke of Hamilton, who is heritable keeper of the palace, has a considerable part of it allotted for his accommodation, and it is now occupied by his family. Other noblemen have suites of apartments, and also different persons who have interest to procure a dwelling here. A large portion of the whole underwent complete repair about twenty years ago, when the French princes sought an asylum in it after the revolution.

The precincts of Holyrood-house, embracing a circuit of about three miles, including the King's Park, Arthur's Seat, and Salisbury Craig, afford a sanctuary to debtors. Thus there are constantly a number of persons either insolvent, or who have experienced sudden reverses, who hope to retrieve, resident in houses of mean appearance within the boundary. A jurisdiction is exercised over them by an officer, called the bailie of the abbey, who is always appointed from some of the law department; and there is a prison pertaining to the abbey, in which they may be confined for debts contracted there, or offences against the inhabitants. The privilege of sanctuary is strictly limited to civil debts. No protection is afforded for breaches of the peace, or crimes of any description. There is a similar sanctuary in Edinburgh, within the precincts formerly appropriated for the royal mint; but here the period of protection from arrest is understood to subsist only during 24 hours.

The situation of no two edifices in the same city can be more opposite than that of the castle and the abbey; the one on a high precipitous insulated rock, the other on a plain, surrounded in a manner by hills: yet they are equally picturesque, equally denoting their respective purposes of strength for warfare, and retirement for tranquillity.

The metropolitan church is dedicated to St Giles; but history has not preserved the reasons which induced the citizens to choose a Saint of Greek extraction for their patron. Nevertheless, he was held in high veneration; and a person of some consequence, who, in the fifteenth century, presented a relic, part of his arm, to the community, was rewarded with the privilege of bearing it at all public processions. But so versatile are the opinions of men, that the safety of the city was endangered in the subsequent century by the anxiety of the multitude to tear the picture of their tutelar saint from the standards, and demolish his image wherever it could be found. All the relics, the sacred utensils of gold and silver belonging to the church, and the rich vestments of velvet and brocade, serving for the priesthood, were then seized on, and sold for the public behoof. This church is an ancient Gothic building, known to have stood since the fourteenth century, and now forms the north side of the Parliament-square. The dimensions of the fabric are 206 feet in length, 110 feet broad at the west end, 75 at the east, and 123 in the middle. A square tower rises from the centre, surrounded by intersecting arches, forming an imperial crown, with pinnacles from the curvatures, and a spire above the whole, 101 feet in height. Four separate places of worship are contained within, which go by different names, but the eastern is the largest, and best deserving attention, consisting of cloisters with high pointed arches, and a lofty roof. Rude monumental sculptures, almost effaced, may be seen on the pavement below, and on the roof inscriptions of considerable antiquity at the junction of the arches. Here there is a seat for the royal family, which is occupied by the commissioner to the General Assembly of the Church of Scotland, as representing the king. The judges of the Court of Session, the barons of Exchequer, and the magistrates of the city, also sit here, where they appear with their insignia of office. James Earl of Murray, Regent of Scotland, who zealously promoted the Reformation, is entombed within the walls of the church; and also Napier of Merchiston, the celebrated inventor of logarithms. In common with other sacred edifices, it was formerly used as a cemetery, and whole cart loads of bones, disturbed by the successive repartitions which the church fabric has undergone, have been removed to other places of repose. Around it also was a burying-ground,
in which the remains of John Knox, the great Scottish reformer, were deposited.

In the steeple of St Giles, there is a set of music bells, or carillons, which are played during an hour every forenoon; and a family performing the ordinary office of beadle, finds a dwelling somewhere in the recesses on the top of the church.

An aisle of this building is appropriated for the use of the General Assembly, which meets a few days in the month of May; other parts are devoted to a police office, and the accommodation of a sergeant's guard. Its uniformity is greatly impaired by every successive alteration; as in one place is to be seen an attempt to restore or preserve the original architecture, which in another undergoes partial demolition; while a third presents what is altogether discordant with both.

The church of St Giles became a cathedral in 1633, on the restoration of Episcopacy, when Edinburgh was first constituted a bishop's see.

Another church, of which the history can be better traced, was founded by Mary of Gueldres, widow of James II., soon after his decease, and is called the Trinity College Church. It occupies part of the valley on the north of the city, and although unfinished, is an edifice of the most genuine antiquity in Edinburgh. The original object of the pious founder was to endow a collegiate church for "a provost, eight chaplains, two boys; as also an hospital for the maintenance of thirteen paupers, and two clerks, who should be subservient to the direction of the provost." The interior now presents a dull and gloomy aspect: it contains no striking monument of antiquity; and although the foundress lies interred in one of the aisles, her place of sepulture is unmarked by any memorial. The hospital which stood south-east of the church having become ruinous, was transferred to a more convenient situation.

There are no other ancient churches now extant in Edinburgh, of many that were once devoted to religious purposes. Perhaps the oldest of all was St Cuthbert's, near the base of the castle rock, which is mentioned in the earliest records; but it was renewed a few years ago, in a plain modern building, capable of containing a large congregation, and decorated with a spire. It stands on very low ground, amidst an extensive cemetery.

The churches of older erection in the city are the Greyfriars, Canongate, and Tron Church. The first of these stands near a spot that was the site of a monastery of the same name, and contains two places of worship under one roof. A cemetery, equally extensive as the former, environs it, wherein are many monuments, recording the existence of celebrated characters. Although this cemetery was probably used as such by the monks, it was not appropriated to receive the bodies of deceased citizens until the year 1561; and about 1612, the church called Old Greyfriars was erected. The New Greyfriars church adjoining, was built in 1721. Most of the children maintained in public hospitals sit in these churches, under the care of their respective instructors.

In the earlier part of the 17th century, a fund seems to have been raised by voluntary contribution, for the purpose of erecting a church dedicated to Christ, which was founded near the castle, on the site of the present reservoir. But soon afterwards, the materials were transferred to a more convenient situation, and what is now called the Tron Church, founded in 1637. In the year 1614, 16,000 pounds of copper were purchased in Holland to cover the roof; but this design being altered, lead and slates were substituted in its place. The whole exterior was lately renewed, and is at present a neat plain edifice, with a steeple and a clock. It appears that, in 1641, it was dedicated to Christ and the church, by the citizens of Edinburgh.

In the year 1647, Margaret Ker, Lady Yester, daughter of Margaret, late wife of the first Earl of Lothian, founded a church, "erected a chapel in the same, which stands amidst a small cemetery, wherein patients dying in the infirmary are interred. The chapel in the abbey seems to have been resorted Canongate, subsequent to the Reformation in 1560, as a place of public worship. But when King James VII. restored it to its original purpose, for the exercise of the Roman Catholic religion, the Protestants were necessarily excluded. However, the inconvenience was not of long subsistence, for Thomas Moodie, a merchant of Edinburgh, having given £1100 sterling, to be employed in building a church, his design was carried into effect by the royal mandate in 1688, and the Canongate church erected. It is a heavy edifice, has the end fronting the street, and stands amidst a large cemetery.

There are two churches for the established religion, entirely of modern erection, in the New Town; the one dedicated to St Andrew; the other to St George. This relic of Papist superstition, the dedication of every new church to a saint, is singular in a country where nothing but strict Presbyterian forms are recognised by the legislature. The former, St Andrew's church, St Andrew's, is a plain building 87 feet by 64 feet, with a small spire, erected in 1688, and is in a good state of preservation. A handsome portico fronting the street, is supported by four columns of the Corinthian order, from which springs a spire, executed in good taste, 108 feet high. The church is lighted by two rows of windows, and a gallery runs along the upper part of the wall; but the extreme plainness of the whole, which is entirely void of relief or decoration, gives a mean aspect to an edifice which would otherwise have been both elegant and ornamental.

St George's church presents a front of 112 feet to St George's, Charlotte-square, with a portico, supported by four Ionic columns, 35 feet high, including the capitals. They are elevated on an extensive flight of steps, forming the entrance to the church, which is 128 feet in extreme width, and can accommodate 1600 persons. A great dome rises from a basement 48 feet square, behind the portico, above which is a circular row of columns, with their entablature and balustrade, surrounded by the upper compartments of the dome. The whole is crowned by a lantern, with a cross, 160 feet above the ground; and produces a fine effect when viewed from different parts of the city or the avenues approaching it. This church was erected at the expense of above £20,000, and opened for divine service on the 5th of June 1814.

These are the principal churches for exercise of the established religion. There are besides, in connection with the establishment, a chapel of ease, which stands amidst a small cemetery on the south side of the town, belonging to the parish of St Cuthbert's, and erected
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Edinburgh, in 1757; another built by Lady Glenorchy in 1773; and two others connected with the Canongate.

A number of the citizens of Edinburgh are very imperfectly acquainted with the English language, from being Highlanders by birth. Those are chiefly among the lower ranks, and their usual communications are in Gaelic only. Two places are appropriated for public worship in that language; one near the Grassmarket, and the other close to the college.

Dissenting Chapels and Meeting-houses.

But many inhabitants of this city professing other modes of worship, there are various churches and chapels in different parts of the city for their accommodation. Of these, the chief for the Episcopalians is what is commonly called the Cowgate chapel, a plain building, which, though, in a very unfavourable situation, stands apart from other buildings. The dimensions without are 90 feet by 75. It has a good organ made by Snetzeler; some paintings; and is decorated with a steepel of moderate height, provided with a bell said to have formerly belonged to the chapel royal of Holyrood-house. It was founded in the year 1771. Another chapel, dedicated to St George, was built in Queen Street in 1794, after a design in Gothic architecture, by Mr Robert Adam; and Charlotte chapel, a building in which nothing but simplicity seems to have been studied, was still more recently erected in the vicinity of Charlotte Square. There are other three Episcopal chapels; one in Roxburgh Place, another in Blackfriars Wynd, and another in Carrubber's Close.

An elegant Roman Catholic chapel is nearly completed, in place of the one which was burnt in the year 1780. The purest Gothic architecture is studied here; the door enters by a pointed arch supported on columns, and the windows are also pointed above. Pinnacles, according to the antique, rise from the front, which is to the east, and produce a fine effect to those who admire the stile adopted. This chapel we believe is about 100 feet long, by 52 in breadth; it stands a little to the south of York Place, with an end front to the street.

There are three meeting houses belonging to the An- tiburghers, four to the Burghers, three to the Relief, two to the Independents, five to the Baptists, one to the Caramonians, one to the Quakers, one to the Metho- dists, one to the Beneziers, one to the Glassites, one to the Unitarians. There being only four Jews in Edinburgh, they cannot hold a synagogue.

Edinburgh is the seat of a presbytery of the same name; it is also the place where the Synod of Lothian and Tweeddale, and the General Assembly of the Church of Scotland, meet for ecclesiastical business.

After the edifices devoted to sacred purposes, those which next claim attention are the buildings appropriated for some of the judicial establishments abounding in this city. A great irregular pile, partly old and partly new, in the Parliament Square, serves for accommodating the supreme courts of justice. In the year 1692, a building for reception of the Scottish Parliament was commenced, and finished in 1840, which constitutes a large portion of it. This consists of one extensive hall, 122 feet in length by 49 in width, and not less than 40 feet high; the inner roof, of a polygonal figure, of massy oak timbers, ornamented with gilding, and supported by abutments projecting from the wall. There is a very large modern window at one end, besides others at the side for admission of light. It is fitted up with benches for different judges, and accommodation for the public, being now converted to a court room; and in a niche there is a statue of white marble of Duncan Forbes of Culloden, who was long president of the court of session. A stranger would, at first sight, conceive it impossible to conduct business amidst the apparent bustle and confusion which prevail in this large apartment, called the outer-house. Sometimes four barristers are pleading at a time before four different judges; attorneys are forcing their way through a crowd almost impene- trable, in quest of counsel already too late for impatience in dispatching causes; conversations are carrying on,criers vociferating names, and a universal murmur pervading the remotest corner. Yet such is the force of habit, that many may be seen quietly studying their papers, while others are engaged in consultations, or the judge gives deliberate decisions without the slightest inconvenience.

At each side of the outer-house are two chambers, each about 40 feet square, with a gallery, and a lofty roof, called the inner-house, where the remainder of the supreme civil and criminal court sit in judgment. The court of session, the former of these, consists of fifteen judges, who sit in two divisions since the year 1808; previous to which there was such an accumula- tion of business, that the road to justice was totally obstructed. Yet a great portion of the evil, perhaps, arose less from the multiplicity of judges called on to decide in each cause, than from the mode in which the procedure was conducted; for had the regulations of court been rigidly enforced, and some skilful, energetic, and upright person been sought out to preside, the court might possibly have remained entire. But there were examples of judges retaining papers a whole year in their possession without pronouncing a decision; and after judgment was pronounced, it has been known, that it was allowed to be objected to above thirty times successively, for the purpose of delay. Besides the interest of the agent and the client were at direct variance: the advantage of the one consisted in protracting the suit, the safety of the other in bringing it to a close; and from the combination of these and other causes, the supreme court entirely lost the confidence of the public. The late division of the judges in 1808, has been attended with infinite benefit; many excellent regulations have been successively made, and although others seem objectionable from not protecting litigants against causes of delay, the justice is undoubtedly more equably administered. The public confidence is restored, and if care be taken in the selection of liberal and enlightened men to fill the seat of justice, it will not likely be again impaired. By a statute, in 1810, no cause, involving a smaller interest than £25, can be brought originally into the court of session, unless by appeal from an inferior judicature; and every cause is first decided by a single judge in the outer-house, on oral or written pleadings. The party dissatisfied may then carry it before either division of the inner-house within 21 days, where all the proceedings are printed, or if pleadings follow, it is on printed papers. Both parties having stated their case, which is deliberately decided, he who is dissatisfied, may bring the whole matter again under review of the same division within an interval of 21 days. If now unsuccessful, his only remedy lies in an appeal to the House of Peers. Thus, the systematic arrangements practised here, are admirably adapted for the administration of the laws.

The supreme civil court sits only 112 days in the year, infinitely too short a period for discharging the public service; and there is an absolute cessation of
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The Justiciary Court.

The Parliament House is a large and imposing structure, composed of chambers, courts, and offices, connected with old buildings and the High Street. The court-room in the eastern wing is an oval room, with a crimson silk roof, and two lobbies below, one of which is to be reserved as an entrance for the advocates to the Parliament House, and a place for attiring themselves in their proper costume. This body has been particularly favoured by government in the part of the new buildings allotted for them. The writers to the signet paid £1,500 for accommodation in the ground floor; and the advocates contributed ground worth only L.2,000 or L.2,500, for a site to the edifice, and the portion they receive, though perhaps not so well adapted for use as a detached structure would have been, is estimated at L.10,000 or L.12,000. Some years ago, the buildings for accommodating the courts of law, certain public officers, and persons in confinement, being found inadequate for their respective purposes, the defect was proposed to be remedied by considerable additions to the Parliament House. Plans and estimates were accordingly prepared, by which it appeared that the whole would amount to L.51,000. However, it was about the same time discovered, that a fund which had long before been appropriated for the salaries of the judges, of later years ceased to be directed into that channel, and then amounted by accumulations to about L.30,000; therefore, above half the expense could at once be defrayed. A bill was precipitately carried through parliament, chiefly founded on the opinions of individuals; and this enormous irregular pile of building has now arisen. But in completing it, the architect has found it necessary to destroy the original front of the Parliament House, to make way for a piazza, forming part of the plan. Perhaps, this is to be regretted, for it was not only ornamental, but intimately connected with the interior, setting aside the expense of that part of the structure from which no material use can be derived.

Immediately adjoining to the Parliament House, and forming part of the new buildings, are several apartments for accommodating the court of exchequer, and a variety of offices under their control, chiefly connected with the revenue. The principal of these is a court-room, approaching a semicircular figure, with a handsome figured stucco roof, commodiously fitted up for exchequer trials. Other apartments are called the treasury chambers, where the barons of exchequer, who are five in number, sit as lords of the treasury, or determine causes without a jury; and various offices fill the whole building, under different denominations. The meetings of this court are held during short terms, four times in the year; but one of the barons is frequently present in the course of the vacations, to oversee and regulate such matters as may be necessary for the public interest. In some of the offices there is a great accumulation of business, and a subdivision into subordinate departments would probably be attended with benefit.

Edinburgh is a royal borough, and the magistracy, collectively called the town council, consists of 33 members, viz. a provost, four bailies, a dean of guild, and treasurer, and the same officers of the preceding year, under the designation of old provost, old bailies, old dean of guild, old treasurer, three merchant councillors, two trades councillors, six ordinary, and eight extraordinary council deacons. All are elected annually; but the provost may be re-elected a second year; the old provost, bailies, dean of guild, and treasurer, are one degree lower in rank than the officiating magistrates of this name, but precede the rest, and are elected as a matter of course, after their own office expiries. There
are fifteen incorporated trades, fourteen of which have an interest in sending a member to the town council, and the council return a representative to parliament. The principal magistrates wear robes on public occasions; also gold chains always while in office, and the provost has a sword and mace borne before him. At present his office is more of a ministerial than a judicial nature; but by strict law, the jurisdiction of the magistrates extends to all crimes, except treason, committed within the city and liberties. In the year 1601, an offender was tried before one of the bailies, at Leith, for stealing a quantity of grain by means of false keys, and sentenced to have his hands tied behind his back, and to be immediately carried out the harbour and drowned. Similar examples are of more recent date, and not long ago, the magistrates were accustomed to banish a culprit without trial by jury, which is a greater exercise of power than belongs to the supreme criminal court of Scotland. Within the city, the provost takes precedence of the officers of state, and all nobility; he is, ex officio, lord lieutenant of the city, and colonel of the town guard. His salary is L. 500 per annum, and L. 300 more to defray the expenses of entertainments.

The bailies preside by rotation during a month, in a court called the bailie court, for trying inconsiderable causes, at which time they are assisted by an assessor, who is a lawyer by profession, and has a small salary annexed to the office. The dean of guild has an extensive jurisdiction. He inspects the weights and measures used in the city; he restrains the citizens from erecting buildings, or making alterations on their property to the detriment of the public, without being deliberately considered; and those that are ruinous, he orders to be examined by a jury of fifteen tradesmen, and pulled down.

The revenues of the city are managed by a chamberlain or factor, whose regular salary amounts to L. 600 per annum.

Part of the Royal Exchange has been lately fitted up to accommodate the various offices and departments necessary for the town council. This building was designed for the resort of merchants, and founded in the year 1753, on the northern bank of the ridge whereon the principal street of the Old Town is situated. From the great declivity, the back wall of the edifice is at least 100 feet high, while the front is only 60. The main body of the building is 111 feet long by 51 in breadth, the south front of a piazza projects, with four Corinthian pilasters, supporting a pediment, with the arms of the city sculptured in stone above. Within there is a spacious staircase, and the entrance is through a porch into a paved court.

There are many inferior judicatories in this city, of which very few are accommodated in public buildings specially appropriated for that purpose; such as the commissary court, a remnant of ecclesiastical jurisdiction, for trial of marriages and divorce, as also actions of scandal or defamation; an admiralty court for trial of cases purely maritime; and a sheriff-court, where almost every question occurring within the county may be brought under discussion. One of the most laudable institutions is the small debt court, wherein the justices of peace preside, and whose jurisdiction is limited to cases not involving a greater amount than L. 5, and the expense is also limited to the nearest trifle, not exceeding a crown. This court sits weekly, legal practitioners are excluded, and the parties state their cause viva voce, unembarrassed by the subtleties of law.

An immediate decision takes place, from which there is no appeal, or at least an appeal is attended with such difficulty, that it is never resorted to. This court has continued fourteen years on its present establishment; during which it has decided 58,510 causes, involving an interest of L. 106,820; 17:8; therefore its decisions are no less than 4179 annually, or about four times the number of those given by the supreme civil court, and the pecuniary interest of the parties is at an average only about L. 1:16:6. The benefit which it affords is therefore very great, especially on considering that it is no charge whatever to the nation; that the services of the magistrates presiding are gratuitous, and the expenses of their clerk and officers defrayed by the litigants.

In 1605, a system of police was devised; but on trial it was found to be in many respects a system of inefficiency and oppression. The obnoxious statute into which it had been embodied was repealed, and, in 1813, a new act, containing a variety of judicious clauses, substituted in its place. The sheriff of the county, and magistrates of the city, are constituted judges of the offences committed within their respective bounds; and they appoint a superintendent of police, who is fiscal or prosecutor on behalf of the public. A number of commissioners are named, under whose charge the streets are cleaned and lighted, and they also take cognizance of other matters connected with the safety and comfort of the citizens. It would be wrong to pass a decided opinion on a system of such short endurance as the present establishment of police; it is undeniable, however, that the statute in general is prudently and temperately framed; though a most important object, economy, seems to have been totally forgotten. The sum levied from the inhabitants the first year, at the rate of 7½ per cent. on the house rents, which is its maximum, was L. 22,000; while the charge of the establishment, including some expenses not subject to renewal, was L. 25,030.

There are two branches connected with the judicial establishments of the country, which may be noticed here, the Register Office, and the prison of Edinburgh. The former is probably the most elegant edifice of which the city can boast; it is appropriated solely for deposition of the records of the kingdom, including writings on which the interests of the individual subject depends, and was erected after a design of the elder Adams. It stands also in the most favourable situation of all others, being north of the North Bridge, and receding forty feet from the street. The building is of an oblong figure, 200 feet long in front, and 120 feet broad; but this is the extreme breadth, as part of a large circular apartment, terminating in a dome above, projects from behind. Here there is a marble statue of King George III. executed by a female artist, the Hon. Mrs Damer. The extremities of the front, and also the middle, project somewhat from the body of the building; where two outer staircases conduct to a landing-place; but these, by a strange inconsistency, are always shut up, and access is gained from behind, by two entrances originally designed as private. There is a small turret at each angle in front; and the royal rooms, executed in a composition, appear in the middle. The interior is divided into two stories, and a sunk storey, and two spacious staircases lead to the chambers above. All these throughout the edifice are arched for security against fire, and paved; they are of various dimensions, but equal in height. The foundation of
this edifice was laid in 1774, and it has cost £40,000, though only half the original plan is completed; nor was that accomplished without very great embarrassment, owing to a deficiency of funds. The total number of chambers was intended to be ninety-seven; but, in fact, the increase of number is attended only with the convenience, that they are longer of being filled. The quantity of writing required for every transaction in Scotland is incredible; more especially if connected with land, or buildings. The acquisition of all property of this description, however inconsiderable in value, requires long and particular deeds, as they are called, of conveyance and investiture; if it is transferred again, the same must be repeated; and if it then goes to a third person, the whole must be renewed. Every paper given in during a law-suit, must be preserved; and every transaction of any importance, from safety or necessity, enters the record. The great accumulation of writings can thence be better figured than described. Nay, it may be remarked, that until lately, the successful litigant was obliged to obtain a copy of every paper in his suit, verbatim, written after a certain form, to enable him to avail himself of his advantage. Within these few years, some arrangements have been made for the better preservation of the records, and publication of the more curious and useful Turions unded.

There are two prisons in Edinburgh, to which may be added the prison of the Abbey, and one, which we believe is no longer used, in the Calton, and Bridewell. The principal prisons are situated in the High Street, and in the Canongate; but they have been devised on principles little consistent with humanity: there is no place for exercise; no circulation of air; no conveniences which health and cleanliness demand; and but few separate rooms for prisoners, who pay certain rents, according to the quality of accommodation. Nevertheless, it is not to be denied, that the unfortunate debtor in Scotland enjoys eminent privileges; nay, in regard to criminals, the liberty of the subject is not to be encroached upon, except in so far as the public security requires. Almost from the day of confinement, the incarcerating creditor may be compelled to provide an aliment for his debtor; and after a month's imprisonment, the debtor may obtain his liberty, by surrendering all his property. Every person accused, can insist on speedy trial, and force it to a conclusion within 100 days. Should the judges require further information, however, he may be remanded to prison. Thus, in the strictest view, there is perhaps less necessity for conveniences, than where pros- trated confinement from unrelenting creditors may ensure; and it is grateful to reflect, that there is a progressive amelioration in the state of prisoners. The prison in the High Street was originally erected for the joint purpose of accommodating the parliament of Scotland, and the supreme courts, and for the restraint of debtors, and malcontents: the last has been its only use since 1641. The better class of debtors are confined in the Canongate jail, which was built in the reign of James VI.; and sometimes, ex speciali gratia, individuals sentenced to confinement by the Court of Jus- ticiary; as in a late instance of a naval officer, who unfortunately killed a seaman. On very recently inspecting the prison in the High Street, we found, notwithstanding all its disadvantages, that much attention was paid to the comforts of the prisoners. Cleanliness was particularly studied; all the ventilation was given which the edifice would admit, and the prisoners were treated with great humanity. Their number amount-ed to forty; but the average throughout the year is about forty-five; of these not above a fourth were debtors, the remainder being confined on accusation of crimes, or as a punishment for committing them. They were divided into two separate and distinct classes, and kept in opposite quarters of the prison; a judicious arrangement, to prevent the contamination of morals. The men and women are also kept in separate apartments, extremely various in size; but among the larger is the condemned hold, whither criminals are con- ducted after sentence of death, and if requisite, chained to a massy iron bar, rivetted to the floor. Here also is a strong iron cage, of small dimensions, which might be employed for the most daring and refractory. An incarcerating creditor pays sixpence per pound on the amount of the debt, for which his debtor is committed; and a Freeman of the city pays two-pence a night of jail fees, which are doubled to all others. A clergyman performs divine service in the lobby or hall of the prison, for which he has a salary of L.80 a year. The principal jailor, who is called Captain of the jail, de- serves much commendation for his exertions to mitigate the hardships of confinement; but the comfort of the prisoners might be greatly promoted, by a very trifling increase in further ventilation and proper soil- age.

The foundation of a new prison was lately laid adjoining to the Parliament House, but, from the apparent want of room, one is to be erected on the Calton Hill for debtors.

Bridewell is a spacious modern building, standing in Bridewell, a very conspicuous situation on the Calton Hill. It was founded in 1791, and opened for the reception of petty offenders in the year 1796. The expense of its erection was defrayed by an assessment on the inhabi- tants of the city and county, so judiciously apportioned as to prove no burden, and an aid of L.5000 from government. In addition to the petty offenders sent here, the commissioners who manage it, are authorised, by a recent statute, to fit up apartments for those unfortunate females labouring under disease, which renders it prudent to separate them from the mass of society. The body of this edifice approaches a semicir- cular figure: it consists of five stories, containing a number of cells; and the governor's house is so placed, that he can see all that goes on within them, and that in concealment from the prisoners. There are thirteen apartments for the purpose of labour in each storey; with a grating in front, and looking into an inner court. The bed-chambers look to the opposite direction, and are lighted by a long narrow window with glass, opening on pivots; each is about eight feet long by seven in breadth, and is provided with an iron bedstead; a straw mat, and a Bible. Wood is excluded in the structure of the edifice, except for doors to the apartments. Prisoners, on being received, are clothed in a costume peculiar to the place; and their own clothes, after being cleaned, are reserved to be restored to them at the time of dismissal. Their food consists of porridge, beer, and broth; and those who are industrious, may procure an enlarged allowance, together with bread. The sole employment of the convicts is spinning by the women, in which many excel, thus proving the indus- trious habits originally implanted in the people of Scotland; and the men pick oakum, or are sometimes em- ployed in digging a garden annexed to the place. Both sexes are allowed payment for their work at a small rate, which is nevertheless still a stimulus to industry; but the expense of their maintenance is deducted. The
whole house is under excellent management; and prisoners, except for the infamy, find it a lighter punishment to be sent there a second time than at first.

Thus, there are excise-offices and a custom-house in this city, not far from each other; both of which were originally built by private gentlemen for their own accommodation. The former is a neat plain edifice, standing in 'St Andrew's Square, receding from the street. The other is inferior in appearance, and stands on lower ground, in London Street. A great deal of business is done in these offices, particularly in the former.

Having described the principal buildings, and their uses, which, in a civil light, are the concern of the community at large, we shall now say a few words on the charitable institutions of this city, and then proceed to consider the literary establishments.

These institutions are either for the relief of the sick and infirm, for the education of unprotected youth, or for the poor and aged. That on the largest and most important scale is the Royal Infirmary, which is a spacious building, near the University, consisting of a main body 210 feet in length, by 36 wide, and two wings, 74 feet long, by 24 in breadth. A statue of George the Second, in a Roman dress, stands in a niche in the front, with an inscription on either side, "I was naked, and ye clothed me;"—"I was sick, and ye visited me." The building is laid out in different wards; and there is a large room at the top, lighted from above, wherein operations are performed; hot and cold baths below; and cells for the restraint of persons insane. A spacious court, where a centinel is always posted, fronts the whole. This institution is now under a system of management, which meets with much approbation: it is attended by two ordinary physicians, and six surgeons, the two senior of whom take charge of the patients and operations. An exact register is kept of the different diseases, their progress, and symptoms; and, as the students at the university have an opportunity of attending the Infirmary, it may be said to constitute a medical school of itself. The different patients are classed according to the diseases with which they are afflicted; and two wards are allotted to the professor of clinical surgery in the University, on the cases of which he delivers lectures. The Infirmary can accommodate 450 patients at a time, or a greater number on urgent occasions; and about 2000 individuals are admitted annually. Of these, between 95 and 110 die; so that the average of deaths scarcely exceeds the proportion of one to twenty; which is extremely small, considering the number of desperate cases which must constantly occur. Patients are admitted on recommendation of respectable persons, who engage, in event of their decease, to become liable for the funeral charges. The funds of this institution are partly certain, partly casual; and the expenditure is dependent on the price of commodities, and the number of patients in particular years; but the charges, at an average, do not exceed L.5 sterling for the relief and maintenance of each, which is a satisfactory proof of the mode in which the funds are administered.

Queensberry House, a large old mansion in the Canongate, has lately been acquired by government, and converted to a military hospital exclusively.

A lying-in hospital, formerly a private dwelling-house, in Park Place, is appropriated for the reception of females in indigent circumstances, who are there attended and maintained until recovery. In the year 1776, a public dispensary was planned by Dr Duncan, senior, professor of the theory of physic, which has been of great utility in affording advice, and supplying medicines to the poor. Numerous patients are relieved, and accounts of the progress of the different diseases are preserved. The Dispensary stands in North Richmond Street.

The principal hospital in Edinburgh for the maintenance and education of youth, owes its origin to the benevolence of George Heriot, jeweller to King James VI., who died the year preceding that monarch. After various interruptions, his intentions were fulfilled, by completion of the edifice since called by his name, in 1650, and at an expense of L.30,000; a very large sum at that period. Instead of being then applied to its original purpose, Oliver Cromwell having taken possession of the city of Edinburgh, converted it into a military hospital; but General Monk, several years after, in 1659, at request of the managers, agreed to withdraw his troops. This is a great quadrangular edifice, of irregular Gothic architecture, with a court within, and a well in the centre. On one side of the court is a statue of the founder, which is carefully decorated with flowers on the anniversary of his birth, when all the objects of his benevolence walk in procession to the Greyfriars' church in the neighbourhood, to hear public service; on which occasion the magistrates of the city are present. Each side of the building is 162 feet long, and the court within 94, both being square. There are 200 windows, almost all of which, to gratify one of the executors of the founder, are ornamented with different devices; and the high angles of the edifice are crowned by turrets. The chapel is rather more than 61 feet by 24, and paved with black and white marble. There are different schools; apartments for the governor and attendants; and a kitchen, which was partly fitted up under the inspection of Comte Rumford, during his residence in this country. The situation of Heriot's Hospital is extremely favourable: it stands in the middle of a small field, with some fine old trees around it: on the north it communicates with the city, though quite detached from all other buildings; and a path from the south leads to the country. The purpose of the endowment is for the maintenance and education of indigent children, the sons of the burgesses and freemen of Edinburgh; and the numbers depend on the state of the funds, conjoined with applications for admission. At first only 39 were received, in the year 1659; in 1753 there were 130; in 1778, 110; but now, in July 1814, there are no less than 175. The average expense of maintaining each, including the necessary expenditure of the institution, is about L.45 yearly. On youth leaving the hospital to follow trades, L.50 is paid as apprentice-fee for them; and those attending a university, with the view of preparing themselves for learned professions, are allowed a bounty of L.120. Thus, there is much liberality practised to promote their welfare. The funds of this hospital are ample; and, as a large proportion consists in land in the immediate vicinity of Edinburgh, they have increased wonderfully of late, and are likely to augment still farther. At present, the annual revenue is reputed to be about L.8500. Recent reforms have greatly improved the whole establishment: the salary of a treasurer newly appointed, is raised to L.500, which is found to be more economical than under former arrangements, permitting him to furnish certain necessary articles for common use.

Not far from this hospital, and still more without Watson's the precincts of the city, is another endowed by George Hospital.

Heriot's Hospital.
Watson, for maintaining and educating the sons and grandsons of poor citizens. It was founded in 1738, and completed in 1741, when twelve boys were admitted. The number has been greatly augmented, and each, on leaving the hospital, receives a bounty for apprentice-fee, and, on attaining the age of 25, a farther bounty, if he produce certificates of good character.

There are two hospitals, on a more limited scale, for the maintenance of young females. The first of these is the Merchants' Maiden Hospital, a plain edifice, where girls, the daughters of decayed merchants, are received. And the other, which is a more regular building, is appropriated for the daughters of tradesmen. In the latter, there are at present 50 girls, who are maintained at an expense of between L.25 and L.30 yearly. Girls pay L.1, 13s. 4d. as entry-money, on admission; and receive a bounty of L.5, 11s. 1d. at leaving the hospital. No entry-money is paid in the other; and the bounties are L.8, 6s. 8d. to some, and L.9, 6s. 8d. to others, on quitting the institution.

The Orphan Hospital was planned by Andrew Gardner, a merchant of Edinburgh, who, being supported by public bodies and individuals, it was erected in the valley east of the North Bridge, in 1784. Its object is more comprehensive than for the children of citizens, as orphans from any part of the kingdom may partake in the benefit of the endowment. None are admitted under seven years of age, and they quit the hospital at the age of fourteen. In the year 1778, nearly 100 children were maintained and educated; at present the number is greater. The building is neat and plain, and ornamented with a spire.

In the year 1461, it has already been observed, that Mary of Gueldres, queen of James II. founded a collegiate church, and an hospital for 13 poor persons, dedicated to the Holy Trinity; but all such institutions, at that period, were more for a religious than for a moral purpose; and, at the Reformation, the hospital was stripped of its revenues. They were restored, however, by a subsequent transaction, and appropriated for the maintenance of decayed burgesses of Edinburgh, their wives, and unmarried daughters; none being admitted under fifty years of age. Each person has a separate apartment, ample provisions, and sufficient clothing; they also receive a trifle annually for the purchase of necessaries, and there is a small library for their amusement. The total number presently on the establishment is 181, at an average expense of L.15, 10s. each. Of these, 56 live in the hospital; the rest are out-pensioners, who have an annuity of L.6. The females are about five times more numerous than the males.

Another hospital, also for the support of aged persons, was endowed by James Gillespie, a snuff merchant in Edinburgh, who died in 1797. None are admitted under 55 years of age; and a preference is given to persons of the founder's surname. The total number at present supported by the institution, amounts to 49, including a housekeeper, chaplain, gardener, and four female servants; and the average expense of maintaining each is about L.27, which testifies prudent and economical management, considering the comforts which are enjoyed. Persons of both sexes are received indiscriminately; and, of 40 now in the hospital, 29 are females. The edifice is a commodious oblong building, situated beyond the south-west verge of the city, amidst a small field, and somewhat withdrawn from the high road. It is ornamented with battlements, and small turrets at the angles, as if the same architecture commensurate with the purposes of a place of defence, should be suitable to one on the verge of the southern district of the city, another in the Canongate, and the third belonging to the West Church parish. All are conducted near the same plan, being appropriated for indigent persons of both sexes, and also children. Those who are able to work, receive a sixth part of the value it produces, besides maintenance and clothing. The first of these is on an extensive scale: it was erected by voluntary contribution in 1743, and is supported chiefly from the same source, and a tax on the citizens. But the numbers relieved are so great, that however liberally the public contribute, the institution is always loaded with debt; which is levied by a new assessment on the inhabitants, and is very considerable at present. The building is large, and so mean in external appearance as sufficiently indicates its purpose. A large committee of managers directs the affairs of the establishment at weekly meetings, and reports of its state are occasionally made public. We are thus enabled to trace the increase of poverty, arising either from the pressure of the times, by which the hands of the benevolent are restrained from the exercise of charity, or from the greater resort of indigent persons to the city. The following numbers were relieved by the aid of the institution, either in the house or out of it.

<table>
<thead>
<tr>
<th>Years</th>
<th>Individuals</th>
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<tr>
<td>1805</td>
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<td>1806</td>
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<td>1807</td>
<td>842</td>
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<td>1808</td>
<td>1000</td>
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<td>1809</td>
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We find, that, from 1st July 1811 to 1st July 1812, of the 1402 persons relieved, there were 741 maintained in the house; and the children nursed at expense of the institution were 55. The average expense incurred for each individual was L.6, 15s.; and the total expenditure L.6160. In the succeeding year, terminating July 1813, of the 1501 persons supplied, there were 842 maintained in the house, and 49 children paid for at nurse. The average expense for each individual was L.7, 7s., covering all charges, and the total expenditure L.7256. But the debt had increased to L.4554, which the citizens are now called on to discharge. In the former year, the deaths in the house were 77, in the latter 55. Thus the numbers of the poor seem to have doubled in about seven years, and the average expense of relieving each has increased an eleventh part in a single year. Connected with this establishment is an adjoining edifice for reception of insane persons. Another, on a more judicious and enlarged plan, is now erecting at a little distance from the city, under the name of the Lunatic Asylum. An asylum for the industrious blind was instituted, principally under the auspices of Dr Johnstone of North Leith, in 1795, which is supported by voluntary contribution, and the produce of labour. Nothing merits greater commendation than the mode of conducting this establishment. The industrious objects of the institution are taught all kinds of employment adapted to their unfortunate situation; and, from the judicious management, the produce of labour exceeds that of
Edinburgh.

Edinburgh. 339

other institutions of the same kind, where the numbers are great. Here matrasses of hair and wool are made; mats and baskets of all descriptions; and some of the blind have even been occupied in weaving.

The preceding observations lead us to remark, that several expedients have been devised, in different countries, for the suppression and extirpation of mendicity. So long ago as the year 1701, a pamphlet was published in Edinburgh, laying down a system for the suppression of begging, and for aliminating the poor. It was then proposed, that a general contribution should be raised by voluntary subscription, for their reception into hospitals or workhouses; that they should be employed in useful occupations, and that the produce of their labour should be sold for indemnifying those who contributed to carry the system into execution. We know not if this proposal was put in practice; but more than a century later, one not dissimilar has been adopted, and, during its continuance, has been attended with complete success. A society, chiefly through the exertions of Mr Robert Johnstone, one of the magistrates of Edinburgh, was instituted in the beginning of the year 1813, for the suppression of beggars, for the relief of occasional distress, and for the encouragement of industry among the poor. All these different objects have been effected. The city is entirely freed of beggars, a great number of suffering individuals have been relieved, and a considerable quantity of work produced by those who were willing and able to labour. During the first eight months of the institution, 622 persons applied for relief, of whom 456 were females; and it would appear, that the applicants had 481 children dependent on them. Every case is strictly investigated, both to shun the hazard of deception, and to afford the proper means of relief. It is then referred to one of several committees, by which it is suitably disposed of. This institution is entirely supported by voluntary contributions, and the produce of labour.

The author above quoted also suggested, in 1701, a plan for suppressing vice and idleness; and in various places societies have been instituted for the repressing of the vices which are principally prevalent in great cities, or for recalling those to innocent pursuits who are not inured to vicious habits. Youth is easily led astray, and mankind too often fall a sacrifice to the artful contaminations of their fellow creatures. In the city of Edinburgh, there is only one institution, so far as we are aware, for such laudable objects. This is the Magdalene Asylum; an institution, of which the purpose is, to shelter, and occupy in useful labour, those females who may be reclaimed from prostitution, to the paths of virtue. An edifice was built for their reception in 1797, north of the Canongate, and they are not exposed to common view. The work performed there is spinning, sewing, washing, and other occupations; and, unlike most charitable establishments connected with labour, the return nearly equals the expense of subsistence. One-third of the value of the work is allowed to the females for clothing. From the date of the institution, in 1797, until the first of January 1813, there had been received into the asylum 202 females; 32 of whom had claimed protection during the preceding year. Of all that number, only 23 exceeded 24 years of age; which perhaps goes to testify, that vicious habits, when longer rooted, become incurable. Most of the whole had been discharged, and sent to service, or were reconciled to their relations; but some proved irremediable. There then remained 50 in the house. It is singular to remark, that although other vices are eradicated, no instance has yet occurred of reformation from drinking; another proof added to a thousand others, of the pernicious effects attending the use of ardent spirits. The expenditure of the house for the year now referred to, was L.1081; while the receipt was L.1099. Of this, the expense of subsistence amounted to L.732; and the produce of labour to L. 528. The funds arise from annual subscriptions, occasional donations, and the value of the work done in the asylum: But as there is no more than sufficient, even with rigid economy, to support the establishment, cases of a very distressing and urgent nature are sometimes necessarily rejected.

There are other two institutions on a smaller scale: Repository one called the Repository, which is a wareroom where the better class of females may privately send their work to be disposed of; the other called the House of Industry. The latter is for the purpose of affording assistance to aged females wanting employment, and for training the young to industry. It is divided into three branches; spinning, the manufacture of lace, and a school for servants. The spinners have sometimes amounted to 30, and the lace-workers to 24, several under 12 years of age. Each is paid for the work performed, after deduction for materials and the expense of the institution.

The charitable institutions of Edinburgh, which have no permanent funds like those already described, or do not make such a prominent figure, are extremely numerous and useful. There is a Lancastrian School Society, having three large schools under its care, where the children of the poor are well taught, partly gratis, and partly at a very cheap rate. The Kirk Sessions have also a Lancastrian School under their management, and ten Sunday Schools, attended by about 600 poor children, who go regularly to church, and are instructed by competent masters in the principles of religion. A Gratis Sabbath School Society, instituted many years ago, has done much good. The number of their schools at present is 55, and the number of pupils 3170. The annual expenditure is about L.190, or 1s. 3d. for each individual. There are various other charity schools. A school for the deaf and dumb is taught by Mr Kinniburgh with much skill and success. A Destitute Sick Society, and two Female Societies, for the relief of aged and indigent women, have rendered very meritorious services to the lower classes of the community. The Edinburgh Missionary Society, the Auxiliary (to the London) Missionary Society, the Edinburgh Bible Society, with its various subordinate branches, the Religious Tract Society, the Society for Propagating Religious Knowledge in the Highlands and Islands of Scotland, the Society for Promoting Religious Knowledge among the Poor, the Gaelic School Society, the Society for the Erection and Support of Schools in Ireland, the Society for the Sons of the Clergy, the African and Asiatic Society, may all be mentioned as affording favourable views of the religious zeal and benevolent spirit of the metropolis of Scotland.

The commercial establishments of this city, in which the public at large may be said to be concerned, are a mercantile chamber of commerce, (wherein matters connected with the advantage of trade and manufactures are suggested,) merchants, banks, and insurance offices. There are three public banks, ten private banking companies, and about twenty-five agencies for country banks, besides the business done for London. All the public banks issue notes, of from one pound to one hundred in value; and these are also issued by three of the private companies, but
of smaller amount, as we believe none are above L 20. In the year 1604, the Bank of Scotland, commonly called the Old Bank, was constituted by act of parliament; the stock of the proprietors being then only L 100,000. Now it amounts to a million, or more. An elegant and commodious edifice has lately been erected near the south end of the Mound, opposite to the High Street, for conducting the business of the bank. The architecture is greatly admired, from uniting an elegance and simplicity free of needless decoration; but this can only be said with regard to the front and one of the sides, for the remainder of the building bears no distant appearance to a great tower of modern structure. Nothing can be more extraordinary than selecting the spot on which it is founded, the bank being exposed to the principal street of Edinburgh, and rising 100 feet perpendicularly; while the front, being on the top of a declivity, behooved to be restricted to very moderate height. It is ornamental, therefore, only in one point of view; and from Prince's Street, the extreme disproportion is disguised by a kind of curtain, consisting of a wall with a stone balustrade, and an opening of doors. On the front there is a coat armorial, with supporters as large as life, which was executed by an artist with only one hand. The lobby is very spacious; the door-ways supported by pillars; and there is a teller's room, of an octagonal figure, fifty feet in length.

The Royal Bank was constituted in 1727, by royal charter, on L 111,000 of original stock; which was, in 1798, enlarged to L 150,000; and now it is a million, or more. Business is transacted in a mean looking building, down a lane of the High Street, in a confined airless situation.

Some years later, in 1746, a company was established for promoting the linen manufacture, and then constituted into a banking company by royal charter, by the name of the British Linen Company. The advantages soon became conspicuous, by the increase of the linen trade, and other commercial concerns. Its capital at first was small, but very lately it has been considerably enlarged, after a good deal of opposition from the other public banks. That such should have arisen in the earlier years of the nineteenth century, when the spirit of enterprise is so great, as also the usual liberality by which it is met, may appear singular. The terms of dealing in simple accounts by the banks, is their lending money at 5 per cent. and allowing 3 per cent. interest on what is lodged with them for periods less than six months. Some, nevertheless, allow 4 per cent. even on daily transactions. Almost all the banks in Edinburgh enjoy a high share of public confidence; resulting from the acknowledged wealth of the partners, and from it having been remarked, that no bank ever failed in Scotland, which did not pay in full. The transactions of the bankers in Edinburgh are in general characterised by great liberality, not only in countenancing the legitimate objects of speculative traffic, but in relieving individuals from temporary and unexpected pressure.

There are several insurance offices here against losses by fire, of which the oldest is called the Friendly Insurance. In the year 1720, several owners of property agreed to insure each other against losses of this description, whereby the party insured had to pay a premium equivalent to a fifteenth of the property insured. The sum thus paid in by the association was declared a joint stock, and each proprietor had an interest proportional to his share; but this interest was annexed to the property, and passed along with it to every succeeding owner; and as it is still transferred in the same way, property so insured brings a high premium, along with the policy of insurance. In 1727, the association was constituted into a body corporate, and their privileges have since been confirmed by parliament.

More recently three companies, each exclusively of Scotch origin, have since been established, under the name of the Caledonian, Hercules, and North British Insurance Offices. The shares of each are divided among a number of proprietors, some of whom are among the wealthy inhabitants of Scotland, and many insurances which would otherwise be effected in England are now done here. The business of all these offices is chiefly, if not entirely, restricted to insurance from fire; life insurance is little understood in Scotland; but there are several agencies for English offices in Edinburgh, where insurance both on lives and against fire may be easily effected, only, the proposal must always be transmitted to the principal office for refusal or approbation. In general this is a profitable concern for the company; because the usual architecture of the houses in Scotland is an effectual safeguard against the ravages of fire. A fire in Edinburgh is a rare occurrence; a house being totally destroyed is almost unexampled; and we do not know where it is preserved on record that a life was lost.

There are numerous public and private literary institutions in this city; at the head of which is the university. The first proposal for establishing a university in Edinburgh, soon after the reformation in 1560, is said to have been opposed by the universities of St Andrews, Glasgow, and Aberdeen. However, one was founded in the years 1580 and 1581, and a royal grant of certain revenues obtained for its support in 1582. Only one professor, a clergyman of the city, seems to have originally been appointed; but others gradually increased to the number of seven. In 1599, the judges, advocates, writers to the signet, and town council, contributed a joint stock for establishing a professorship of law, and Sir Adrian Damman, a Dane, was the first who held that office. A professorship of Hebrew was instituted in 1610, and Conrad Otto, a learned Jew, appointed by the magistrates to discharge its duties. Successive chairs were established, either under royal patronage, by the magistrates of the city, or by the liberality of private individuals: of the latter description is a modern endowment by the late Sir William Pulamen, for a course of lectures on agriculture; and still more recently, an ample fund has been bequeathed by General Reid, for instituting a professorship of music, to be applied to that purpose on the decease of certain relatives by whom it should be liferented. So lately also as the years 1806 and 1807, the crown created two new professorships, one for military surgery, and another for medical jurisprudence. The total number of chairs now amounts to 27, which are classed as follows:

Faculty of Theology.
Divinity.
Church History.
Oriental Languages.

Faculty of Law.
Civil Law.
Scots Law.
Civil History and Antiquities.

**Faculty of Medicine.**
Anatomy and Surgery.
Practice of Medicine.
Botany.
Materia Medica.
Chemistry.
Theory of Medicine.
Midwifery.
Natural History.
Clinical Surgery.
Military Surgery.
Medical Jurisprudence.

**Faculty of Arts.**
Moral Philosophy.
Rhetoric and Belles Lettres.
Greek.
Latin.
Natural Philosophy.
Mathematics.
Practical Astronomy.
Logic.
Agriculture.

On three of these branches, the law of nature and nations, civil history, and practical astronomy, no lectures have been delivered for several years. The salaries of the professors are for the most part about L. 100 per annum; though some have less and some considerably more; and fees of L. 9, 5s. in some classes, and L. 4, 4s. in others, for the session, are given by each student. The professor of Divinity receives no fees, and those of one class of civil law are L. 5, 5s. The mode of instruction is by lectures; no particular course of academical education is followed, nor do the professors exercise any control over the other pursuits of the students. The professors lecture in gowns, but the students are not distinguished by a particular costume; each attains what lectures he prefers, and he lives where and how he pleases. Particular professions, such as medicine, law, and theology, require a regular attendance at certain classes previous to being qualified for exercising them, certificates of which must be produced before degrees are obtained. The senatus academici forms a liberal and learned body of men, and the reputation of the university bears ample testimony of their capacity. As a medical school, there is perhaps none of greater celebrity in Europe, and students are to be seen attending it from various quarters of the globe. The total number of students at this university during the session, terminating in spring 1814, was 2010.

The buildings appropriated for the professors instructing their respective classes being found mean and inconvenient, an enormous pile was founded, in 1789, the expense of erecting which was attempted to be defrayed by subscription. But although the public displayed unusual liberality, the plan was so gigantic, as might indeed have been anticipated, when compared with the means of putting it in execution, that after a few years of activity the buildings became altogether stationary, and long exhibited the appearance of a stupendous ruin. Some pecuniary aid has lately been obtained, and part of the structure further advanced in consequence. The edifice was planned by the late Mr Robert Adam, and intended to consist of a great qua-
drangle 338 feet by 255, fronting the east, with a spacious court in the interior; and the expense of the fabric was calculated at L. 68,000. Most of the front, and the north and west walls are finished, and part of the internal edifices. The principal gateway enters from a portico, supported by columns of the Doric order, each of single stone, 25 feet high, and, when complete, a lofty dome is to crown the whole. Besides the class rooms adapted for giving lectures on the various branches taught in the university, a very large apartment for a library, and one for a museum of natural history, the college was originally designed to contain accommodation for the chief professors, which we believe is now to be adopted. From the present state of the buildings, it will be many years before they are brought to a close; meantime we cannot but regret, that more recent edifices have been allowed to crowd and encroach on what was meant to surpass all other structures in Scotland.

The High School, devoted to the education of boys, is a compact, plain building, well corresponding to its use, situated in an open area, near the royal Infirmary. It was founded in 1777, and consists of apartments where the different classes are taught, a common hall and library. There are five teachers, one of whom is denominated rector. Each teacher has his class with him during four years; at the end of which time it is put under the tuition of the rector, with whom most of the boys continue for two years longer. A public examination annually takes place in August, when premiums are distributed. Some of the masters of this school have been much distinguished by their literary qualifications; and it has given the elements of liberal education to many who have afterwards made an eminent figure in the world. So high does it stand at present in the public estimation, that it is attended by above 700 boys. Being found too small for their accommodation, it is about to be enlarged.

Besides these, which are the chief public institutions in this city for instruction, the elementary parts of science and literature are taught, either in the way of lectures or otherwise, by private individuals, according to the age and capacity of the pupils.

An association was established in 1810, under the name of the Edinburgh Institute, where scientific persons lecture alternately on certain subjects previously announced; those for the present year, 1814, are natural history, astronomy, magnetism, and Oriental history. Each lecturer receives a guinea for his lecture from a general fund, and the lecture room is open for a small consideration to all who may chuse to attend it. Anatomy and chemistry are successfully taught by private lecturers to numerous audiences; and there are many instructors of the arts and accomplishments, distinguished by their ability. A royal academy for horsemanship was established in 1769, the master or director of which has a salary of L. 200 per annum. There is also an academy for design, under the patronage of the Board of Trustees for encouraging manufactures, the master of which has a salary of the like amount, for the attendance of numerous pupils. Drawing, painting, and music, are besides taught in all their branches, by many different persons.

There are various societies in this city for the cultivation of science and literature, the principal of which is the Royal Philosophical Society. Associations of learned men are numerous on the continent, and some of them have subsisted long. The Royal Academy of France preceded the Royal Society of London; but a much longer interval elapsed before any similar asso-
A Society of Antiquarians was constituted by Royal charter in 1781, for the purpose of investigating antiquities in general, but more particularly those of Scotland. The number of associates is considerable, and they have a small museum; but only one volume of Transactions has been published, and an interval of twenty-four years has not produced another. Although this nation can boast of eminent historians, the genuine study of antiquity is not a popular pursuit at present; indeed it is vain to deny, that works of frivolity, those which engraft an erroneous description of the manners of our forefathers on imaginary events, have vitiating the taste of the public.

A society for the promotion of natural history was instituted about the same period as the former: many valuable compositions were read in it during a series of years, and a small library was collected for its use. But after having declined for some time, it may be said to be entirely supplanted by the Wernonian Society of recent institution, which embraces the same objects. The name, however, is considered as inferring something circumscribed, and is therefore unpopular; for the public justly consider that they ought not to be fettered to any particular tenets in natural history, and least of all to geological theories, yet of such uncertain foundation, and on which the reputation of Werner is principally founded. Some of the most intelligent naturalists have been deterred by these considerations from joining it. Two volumes of Transactions have been published. There are two extensive societies, the Caledonian Gardener Society, chiefly restricted to practical persons, and the Horticultural Society, belonging to this city, both of which award premiums for fruits and flowers at certain seasons. The latter is on a more general scale, in respect to the quality of its members.

A society for promoting astronomical science was lately instituted; and now consists of many respectable individuals. As yet it has produced no Transactions; but by means of its exertions, an observatory, erected some years ago on the Calton-hill, a situation particularly favourable, has been judiciously repaired, provided with several good instruments, and is likely to be preserved in such a condition as to prove useful to the public.

There is another association, on a more comprehensive establishment than any of those we have hitherto mentioned, which may be described as a great patriotic economical society. This association was originally formed for promoting the welfare of the Highlands of Scotland, and is called the Highland Society; but its views are at this day greatly extended, and whatever is connected with the prosperity of the country at large is brought within the sphere of its patronage. Thus it is occupied in advancing the interests of agriculture, manufactures, and the arts, by offering premiums for competition; and all useful inventions and improvements, relative to the same objects, though not originally proposed by the society, are also recomposed. To attain an accurate knowledge of the real state of the country, different districts are periodically selected, and premiums offered for the best report regarding them; the culture of certain vegetables, promising utility, is encouraged; the adoption of implements of agriculture and machines, which have come to the knowledge of the society, is recommended; and when ingenious mechanics, in straitened circumstances, have devised models which apparently might be beneficial, if executed on a sufficient scale, are unable to complete them, sums have been bestowed for that purpose. About £650 is yearly distributed in premiums; a gold medal is occasionally bestowed, and sometimes pieces of plate to those whose merits seem to entitle them to it. The ample funds of this society, the patriotic spirit of its members, and the countenance which it receives from government, all contribute to its general utility and importance. It now consists of above 1200 members, and volumes of Transactions are occasionally published.

The diffusion of knowledge is justly deemed an essential means of civilizing a nation: the government itself is materially influenced by it, and thence the happiness of the people. A literary government is mild, but experience proves that a military one is tyrannical and despotic. Thus in the largest and most populous empire of the world, none but men who have undergone a probation in literature, are admitted to share its administration; and notwithstanding its unwieldy greatness, universal tranquillity prevails: all its measures are mild and paternal. Edinburgh has been called a hot-bed of genius. It is not to be denied that brilliant talents have shone in it; that it has given birth to many celebrated works in history and philosophy; yet in appreciating what ought strictly to be denominated learning, much must be rejected that passes for such in the vulgar eye: little originality is truly seen; the ideas of mankind, always the same, are only reproduced under a different form; every field of ordinary discussion has been exhausted again and again; and unless for scientific inventions, and exposing the phenomena of nature to view, scarcely any thing new is to be found. The diffusion of knowledge is materially promoted by the facility of access to public libraries, and few cities are more favourably situated in that respect than the Scottish metropolis. In the year 1550, Clement Little, an advocate, bequeathed his library for the use of the citizens at large; and immediately on the institution of the university, the books were transferred thither by an order of the magistrates. This considerable collection, of which a catalogue is still extant in the records of the town council, was gradually augmented by the benefactions of Drummond of Hawthornden, and more recent donors, until it now forms a great accumulation, probably exceeding 50,000 volumes. By a statute passed in the reign of Queen Anne, the College Library is entitled to a copy of every book entered in Statieners-hall, in common with the other universities. The whole collection is preserved in three apartments, one of which is a very fine room, though wanting repair, 83 feet in length, hung with many old portraits of foreign literati, and those of Scotland. Among the latter are King James VI, his preceptor George Buchanan, and the first professor in the university. Besides the printed books, there are some historical and classical manuscripts, which have been put in good order, and separated from the others. There is a copy of Fordun's Scotichronicon, written on vellum, and a protest taken against the burning of the early reformers John Huss and Jerome of Prague, by a convention of the Bohemian states, with numerous seals appended. The library likewise possesses a copy of Bellenden's translation of Boethius, printed on vellum, of which only three copies besides are known to
exist, and the *Heures a l'usage de Rome*, also printed on vellum, which is shown as a manuscript. Students have the privilege of borrowing books on depositing their value with the librarian, who is always one of the professors; and each contributes five shillings, which are the sole funds supporting it, on being enrolled in the university register. It is to be regretted, that there is no complete printed catalogue of this collection.

Besides this library for the use of the students in general, there is an excellent one belonging to the divinity hall in particular, furnished with books not only on theological subjects, but on those also of general knowledge.

But the largest and most celebrated library in Scotland is one belonging to the Faculty of Advocates, which was founded by Sir George Mackenzie, in the year 1680. Here the number of printed volumes now exceeds 70,000, and there are about 1000 volumes of manuscripts; the whole are enumerated in a printed catalogue, of above 1700 folio pages, the last part of which was terminated in 1807, except 10 or 12,000 articles contained in the apparatus catalogues. This library possesses many rare, curious, and valuable printed works, and a number of important manuscripts; among the latter are the records of thirteen of the religious houses preserved from the general destruction which took place at the Reformation; the two earliest records of criminal trials in 1494 and 1506; several confessions of faith, written on parchment, with the original subscriptions of those who swore to maintain the established religion; a valuable manuscript of Martial's Epigrams on vellum, nearly 1000 years old; beautiful manuscripts of the Bible; a copy of the gospels in the Malay tongue, written on the leaves of trees, and various treatises on law and history. The printed works embrace every department of science and literature, but more particularly the classics, history, antiquities, and jurisprudence. Among the more curious works, may be named the Mazarine Bible, in two volumes folio, which is probably the earliest printed book with an impression on both pages, and may be dated about the year 1450. It is in the Gothic character, clear and entire as it came from the press; and for the sake of preservation, is never exhibited but by a particular order. This book was purchased in 1805 for 150 guineas. The library also possesses the first and second books printed in Scotland; the one in 1503, containing a collection of maxims and poems of little intrinsic value; the other, dated 1509, is the Breviary of Aberdeen. There are several works printed on vellum, particularly a breviary of the Roman Catholic church, of large size, in black and red, ornamented with beautiful illuminations, from the Venetian press of Jenson, in 1478; a fine copy of the *Heures a l'usage de Rome*, every page of which is bordered with engravings, printed about 1507; a copy of certain Scottish statutes, dated 1541; the *Antiquaria Supplectitis Portucnulæ* of Petavius, in 1610; and three modern works by the same author, printed at Edinburgh in 1809, 1811, 1814. It may easily be conceived, that a library which has subsisted between 150 and 140 years, and belonging to a body always distinguished by learning, must have accumulated an infinity of valuable works. Accordingly, we find, among others, the *Thesaurus of Ecclesiastical Antiquities* by Ugolini; those of the Greek and Roman antiquities by Gravius and Gronovius, with the supplements; the first editions of Homer and Cornelius Nepos; and the modern editions of classics most in repute. There are here the French *Encyclopédie*, as originally published in folio, by D'Alembert and Diderot, and the *Encyclopédie Méthodique*, so far as complete, in about 150 quarto volumes; some other French works of the same description, and all the celebrated Encyclopédias in English. The Transactions of different learned societies belong to this library, as those of the Royal Academy of France, the Memoirs of the National Institute, and the Academy of Inscriptions; the *Memorie della Societa Italiani*; and a valuable collection, called the Scrittori Economici di Milano, in 44 octavo volumes. All the celebrated French scientific journals are here, as the *Journal de Physique, Annales de Chimie, Annales des Arts, Journal des Mines*, and some less important productions, both in French and English, as *L'Esprit des Journaux*, a collection now exceeding 400 volumes; reviews and magazines. There is a set of the *Moniteur* complete, for which the Faculty lately paid above L.250. In typography, the library possesses the works of many eminent printers, such as Fast and Guttenberg, Jenson and Aldus, of the older class, and those of Bodoni, Ibarra, and Degen among moderns; besides the productions of the most esteemed printers of Britain. There is an Egyptian mummy in the original case, belonging to the library; a cabinet of Greek and Roman coins, which are but partly arranged; and a very fine collection of Scottish gold, which is in perfect order. The expense of this establishment is about L.1500 per annum, of which about L.1000 is devoted exclusively to the purchase of books; and the library is besides entitled to a copy of every work entered at Stationers' Hall. With these advantages, greater progress would be made in other hands; but the constant change of management, and the little regard paid by the Faculty to the choice of those of their own body, who oversee the whole, proves a great retardation. Although this is entirely a private collection, ready access is allowed to strangers; and if any reputable literary person has occasion for expensive works, which he himself does not possess, they are purchased by the library for his accommodation; a praise-worthy liberality. Thus, it proves of infinite use to the public; and we should be wanting in gratitude did we neglect to express our sense of the assistance which this work has derived from its ample stores.

There are several smaller libraries in Edinburgh; such as one belonging to the writers to the signet, containing 10,000 or 12,000 volumes, which is under good management, and in excellent order. A library lately instituted for biblical criticism; two private subscription libraries, and some others. There are also six or eight circulating libraries, where works of merit may occasionally be found; but only novels, and that portion consisting of books of mere entertainment, are in common request.

We have yet to speak of the population of the city, population, the division, and pursuits of the people, in so far as not anticipated by the general notices already given. Edinburgh consists of 13 parishes, St Andrew's, Canongate, College Church, St Cuthbert's, St George's, New Grey Friars, Old Grey Friars, High Church, New North Church, Old Church, Tolbooth Church, Tron Church, and Lady Yester's, which are subdivided into 20 wards. The total population amounts to 82,624 individuals, of whom 35,275 are males, and 47,329 females, being an excess of 12,064 of the latter. The total number of families amounts to 18,183; thus each is found to consist of between four and five individuals; or one half the families may be computed at four, and the other
half at five. The number of families engaged in agriculture is 272; in trade, manufactures, and handicraft operations, 7,432; and those employed otherwise amount to 9,579. Thus, the individuals supported by agriculture, trade, and manufactures, does not exceed 31,000, a very small proportion of the whole. It is to be observed, however, that a portion of the most populous parish being in the country, the general amount would be diminished to 77,786, by deducting it; but making a reasonable allowance for omissions, which indubitably took place, the whole population will be found to consist very nearly of 80,000 souls. We are well aware, that many are of opinion that the population exceeded this number twenty years ago, and that it has always been increasing; but we are much inclined to doubt the progressive increase. It can take place only by an influx from the country, or by the greater frequency or greater fertility of marriages. But the expense of subsistence must undoubtedly operate as a partial check on the former, and in no town in the world perhaps are there so few marriages. The excess of females proves the fact in some degree, and it may be owing to a similar cause with the other, namely, the expense of subsistence. The city has extended wonderfully indeed, not so much, however, from new inhabitants seeking an abode, as from those previously residing in it requiring more accommodation. It is indisputable, that there is a gradual and continued migration of the older and less commodious parts of the town to occupy the edifices daily erecting, while their places are left vacant, or are occupied only by similar numbers. But if 61 houses, which we find were building in the year 1811, received as many families from the country, the accession of population would not be great, allowing the due proportion to each; and at that time a number of houses were uninhabited. Thus we are induced to conclude, that although the population may be increasing, the ratio is inferior to the general belief. But to obtain an accurate view of the population of a nation, the whole list, town and country, should be taken up on the same day.

There are few persons of high rank citizens of Edinburgh, or those not engaged in professional pursuits. Almost all are actively and industriously employed, and chiefly in quest of subsistence. The principal professions are the bar, medicine, surgery, that of attorney, and the more liberal mercantile vocations: the ecclesiastical establishment is so confined, that it can scarce find a place in calculation. As families of the highest rank frequently breed their younger sons, or sometimes the eldest, to the bar, the law is usually placed first in order.

The barristers are united in a society, called the Faculty of Advocates, who have the privilege of pleading in all courts, even in the House of Peers, and can claim exemption from prosecution in any but the supreme court to which they belong. The only exception is in regard to a useful judicial institution, of which we have already treated. Candidates for the gown undergo successive examinations in public and private, and they must produce certificates of an academical education. There are at present 276 advocates enrolled on the list, but not above half the number practise at the bar, and scarcely more than 50 gain a livelihood exclusively by their profession.

The first class of attorneys is denominated clerks, or writers to the signet, because they have the privilege of signing certain writings which pass the king's signet. All must serve a long apprenticeship, and undergo trials of their skill in law, before being admitted to practise. The number is at present 367, most of whom follow the profession. As a safeguard to the public, they are permitted to charge their clients only at a certain rate, according to a table of fees submitted to and sanctioned by the Court of Session.

Another branch of the law department consists of solicitors united into a faculty, who practise in the supreme court as attorneys; and some whose profession is of a mixed nature, participating of that of advocate and attorney conjointly, who practise in the inferior courts only. We have been unable to ascertain the numbers engaged in the various branches of the law department, but they probably amount to several thousands.

The medical profession is very celebrated in this city. It consists of two Royal Colleges, the one of physicians, the other of surgeons. Several distinguished foreigners are enrolled among the former; but there are few physicians who practise in Edinburgh. By their charter of incorporation into a college in 1681, and subsequent statute, they were enjoined "to visit all the apothecaries shops within the city and liberties, at least twice a year, and destroy all insufficient and corrupted drugs." The public meetings of the college are held in a beautiful edifice in George Street, called the Physicians' Hall, perhaps unequalled in the city. It is built after the antique, and is in dimensions 83 feet by 63. The entrance is gained by a flight of steps to a portico, supported by four columns of the Corinthian order; and within is a spacious hall, with a gallery supported by ten fluted columns.

A corporation of surgeons was constituted in Edinburgh so early as the year 1505; but, by a strange association, united the barbers of the city, as a thing universal in Europe at the time. This incongruous bond was broken; and, in 1557, the surgeons and apothecaries rejoined in one corporation, more lately formed into a royal college in 1778. The college consists of many skilful, intelligent, and respectable members, whose fame has materially added to the celebrity of the medical school of Edinburgh.

This city cannot be called a place of trade or manufacture; it is chiefly supported by persons in the law and medical departments, especially the former, and by families whose children are attending the high school or university, and other branches of education. But the great bulk of the inhabitants are not engaged in productive industry, compared with many cities of equal extent. There are numerous manufactures, it is true, but almost all are on an inconceivable scale, and conducted without the limits of the city.

There are several distilleries in the suburbs and immediate vicinity of Edinburgh, where great quantities of spirits are made. Independent of what is exported, there are no less than 1048 shops in the city by which they are retailed, and 555 in the county; that is, 1603 places to supply those who require this pernicious beverage. The consumption is too forcibly demonstrated, by the number of dealers finding it advantageous; and but for the attendant expence, it is unquestionable, that the demand would still be greater. For a considerable time extensive breweries have been established for the different kinds of malt liquor, some of which is exported to London. The ale in particular has long been celebrated. Sugars are refined, though not in quantities; and soap and candles of good quality are made.

The preference given to English broad cloths renders the woollen manufacture languid; and from the exten-
five manufactories of Glasgow and Paisley supplying the capital with cotton goods, they cannot be fabricated here equally cheap. But the linen manufacture is flourishing, and that of silks and sarsnets is daily gaining ground. Between 300 and 400 weavers are employed in it; and beautiful shawls are made, of which the prime cost sometimes amounts to twenty-five guineas. Quantities of silk stockings are made, but sent to England for dyeing. There is also a small manufacture of fringe and worsted lace. Such manufactories are greatly encouraged by a board of trustees established in the earlier part of the preceding century. Premiums are there offered for the best commodities, at a certain price, as the best dozen of shawls at five guineas each, or the best linen, of an appointed texture, at so much a yard; and after due consideration awarded. But the manufacturer competing, must part with his goods, if any member of the board, or another, is willing to take them at the value, which prevents articles of greater worth than they ought to be from being put in competition for the premium. The tanning of hides is a large branch of manufacture, and formerly great quantities of shoes were made for exportation. Buttons were also made in quantities, and a small steam engine employed in the different operations of the work; but we believe it is not carried on at present to any great extent.

Household furniture is made in quantities, both for home use and export; and the fabrication of travelling carriages occupies a number of hands. Perhaps, however, while their quality is improving, the demand is decreasing. There are several manufactories of cart and carriage wheels, of agricultural implements, and machinery for mills.

Of late, a considerable trade has been carried on by lapidaries, not so much in the greater operations of marble cutting, which is also practised, as in the polishing of the beautiful pebbles so common in Scotland. The avidity with which these are required, as personal ornaments, by strangers visiting the metropolis, has proved a great encouragement to dealers; but the Edinburgh lapidaries do not understand the art of working in the precious stones, though some are expert in cutting facettes on those of inferior hardness.

Seal engraving is well executed; and engraving in relief, after the stile of the antique cameos, has sometimes been attempted. There are many copperplate engravers, who are often employed for the London market. Excellent specimens of their skill may be seen in the Plates of this Work. A few busts are executed in marble; casts in plaster of Paris are rarely done; and there are artists who work beautifully in enamel.

The fabrication of musical instruments has much increased within these ten or fifteen years. And during a sudden and ill-advised spirit of speculation in trade to Buenos Ayres, in the year 1806, piano forte were to be a considerable article of export. But there is a strong prejudice in favour of London made instruments, therefore many of home manufacture are merely lent out on hire; and there is probably no city in Europe where they are so invariably seen an article of domestic furniture. A single shop has been known to have above 100 out on hire at a time.

There are several iron foundries here, where extensive orders are executed; and also brass foundries, where the smaller work required by breweries, distilleries, and steam engines, is finished. Bells of moderate size are likewise founded, but, we believe, that no cast of any magnitude has been recently produced in this city, nor is such almost ever required, unless we except one of nearly a ton weight, which Mr Armstrong has founded for St George’s Church. Besides, the vicinity of Carron, a foundry celebrated over the world, renders it a powerful and depreciating rival. Though the art is well understood, and sound and beautiful metal produced, difficulty seems to attend any cast in brass exceeding the weight of 40 pounds.

There is an extensive manufacture of cotton cards near Edinburgh, which we have understood carries on a regular traffic with the city of Morocco. A glass-house has lately been established in the city, where excellent glass is blown; a seasonal substitute for what was formerly manufactured at Leith.

A great quantity of paper is made in the neighbourhood, and much is also imported from London, for English writing papers are in general preferred. But the quantity of paper, on the whole, is not equal to what it was in some of the former years. However, the consumpt in printing law proceedings, and the books published in this capital, must always be considerable. Bookselling and printing are among the principal trades carried on in Edinburgh. The number of booksellers has nearly quadrupled within twenty years; and, in 1806, it was calculated, that 120 printing presses were at work in the city. It has been said, that 100,000 Bibles are annually thrown off by the king’s printer, who enjoys this as an exclusive privilege. Works of literature and science, which would formerly have been printed and published in London, are now printed and published in Edinburgh. A considerable deal of work is likewise done by the Edinburgh printers on commission, for London booksellers. Music sellers have increased nearly in the same proportion, but almost all merely deal in retail, nor does it seem so profitable a traffic as the former. It is rare to find a variety of music with them, except for the piano forte.

Nothing but the ordinary trades, found in towns of lesser population, are carried on here, and none in particular to great extent. The traders supply both the city and the country; and 232 carriers are weekly employed in transporting goods. But a large proportion of these is in transitu to Leith harbour for export. However, the whole quantity conveyed in this way is probably about 500 tons weekly. The principal articles of trade are silver and plated articles, jewellery, and cutlery, almost all brought from England; Leather, cloths, silks, linens, and stockings; groceries; books and paper; wines and spirits; Such articles are for home consumption in general, and few for export.

Various improvements in the city and its suburbs are Projected in contemplation. The most important of these is the improvement access to Edinburgh from the cast over the Calton hill. We have not room for any minute description of it. But when we think of the continuation of Prince’s Street through Shakespeare Square—the magnificent bridge that is to connect it with the hill,—the elegant and spacious public buildings that are to be erected there—the new town which is to be built on the eastern declivity—and the rich, magnificent, and extensive prospects which are to be seen from the eminence in every direction, and to which there will now be the greatest facility of access—we figure to ourselves one of the most tasteful improvements that have yet taken place about Edinburgh, and one of the grandest and most enchanting scenes that can be seen in any part of the world. It is but justice to record, that though the plan which embraces so much advantage, and so much beauty, was suggested a long while ago, we believe by more than one individual, we are indebted for the efficient pro-
The public amusements are the theatre, concerts, and assemblies. The theatre is small, plain without, but neatly fitted up within; when very full it produces about L.180; when over flowing, about L.200. On the whole, it is but poorly attended—solomon or never crowded, indeed, except when an actor of first rate talents happens to perform. Card assemblies can scarcely obtain a company, and dancing assemblies are full but seldom throughout the winter. The rooms are admirably adapted for this amusement, one being 94 feet long by 42 in width, and 40 high; besides others sufficiently spacious. A concert on an excellent principle subsisted near a century, but it was given up about the year 1797, from want of attendance. Another was established in 1819, under the name of the Amateur Concert, where it was intended the performance should chiefly be by gentlemen. After subsisting two seasons, it also was abandoned, from the city producing too few amateurs to preserve the performance in the style that was desirable. Public places are now very much superseded by private parties, which are preferred, for reasons that we have not leisure to investigate, nor limits to detail.

The manners of the inhabitants of Edinburgh are characterised by sobriety and decorum. We meet with elegance among the higher ranks; respectability and good sense among the middle classes; honesty and industry among the common people; and such a degree of intelligence among all, as the literary metropolis of a well-educated kingdom might have taught us to expect. (c)

**EDUCATION.**

*Education, in the most extensive acceptation of the term, comprehends every thing, whether systematic or accidental, which has any influence in developing, or biasing, the powers of the mind, and the tendencies of the heart. The object of systematic education is to cultivate the intellectual and moral powers, with a view to some specific result: and education is good or bad, proper or improper, complete or deficient, as the end which it proposes is laudable or reprehensible, as the course of discipline is more or less conducive to that end, and as the means employed are adequate or inadequate to its accomplishment.*

To promote the happiness and the excellence of the individual, to render him a valuable member of society, and to accustom him to aspire, by the regular discharge of all his religious and social duties, to the happiness which awaits the good in a future world, are the great ends which should be kept in view in the education of all, whatever place in society they may be destined to occupy, from the son of the meanest cottage, to the heir apparent to the throne. But the indefinite variety of relations in which men stand to each other, require a corresponding variety of accomplishments, to enable them to fill their respective stations with respectability and satisfaction to themselves, and with advantage to the community to which they may belong. Education, therefore, is either general or particular: general, while it regards us assentient, moral, and intellectual beings, susceptible of happiness, and capable of improvement; particular, when it is designed to qualify us for some particular station, or occupation in life.

In whatever light we view education, it cannot fail to appear the most important subject that can engage the attention of mankind. When we contrast the ignorance, the rudeness, and the helplessness of the savage, with the knowledge, the refinement, and the resources of civilized man, the difference between them appears so wide, that they can hardly be regarded as of the same species. Yet compare the infant of the savage with that of the most enlightened philosopher, and you will find them in all respects the same. The same "high-capacious powers" of mind, "folded up" in both; and in both, the organs of sensation adapted to these mental powers are exactly similar. All the difference, which is afterwards to distinguish them, depends upon their education. While the mind of the savage, left entirely neglected, will scarcely raise him above the level of the animals around him, insensible to all the wonders of creation, and shut out from all the treasures of nature, the more fortunate member of enlightened society, whose capacities shall be evolved by a proper education, will comprehend within the ample range of his intelligence the universe of God; all the beauties of creation will lie unveiled before him; nature will unlock to him her sacred stores, and reveal her secret laws; the powers of other creatures will become subject to his control; and the faculties and the attainments of men will be made subservient to his advantage or his delight. Such is the importance of education to the intellectual improvement, and consequently to the happiness of man. But it is not by his intellectual improvement alone that it enlarges the sphere of his enjoyment. It opens to him sources of still more exquisite pleasure, in the moral and religious
tendencies of his nature. The untutored barbarian, like the beasts which he hunts for subsistence, or from which he dreads destruction, acts merely under the guidance of instinct, or from the impulse of appetite, passion, or feeling. A stranger to control, he acknowledges no law but his own will. Not disciplined to subordination, or trained to reflect on the relations of society, and the duties which arise out of these relations, he submits to no superior, but the leader whom he chooses to conduct him to the gratification of his private or national animosities; and his wildest desires are indulged without the slightest regard to any future consequence, or to any feelings or interests but his own. His enjoyments, therefore, are entirely selfish; and gloomy as they are contracted, they spring merely from the gratification of the most ferocious passions, or the most grovelling appetites. Even his religion tends only to debase his nature, and to increase his wretchedness. His devotion is a feeling of terror; and the whole system of his superstition is a fabric reared by his vices, which it serves, of course, to fortify and confirm. Ascribing to his gods his own passions and partialities, he hears in the thunder and the hurricane only the voice of their wrath, which he is led to appease by some dreadful expiation, or by some deed of sanguinary vengeance against their enemies and his own. He may hope for immortality; for who ever left the precincts of this world, without casting forward an anxious look to another? But the scenes which he pictures to himself beyond the limits of time, derive all their colouring from his own dark imaginat ion; and the expectation of a heaven, not of tranquil benediction, but of insulting triumph over vanquished foes, infuses to greater violence the malignant passions which rankle in his breast. Can a nature thus selfish, thus fiend-like, thus wretched, be transformed by any culture into the likeness of man, as we contemplate him in the more enlightened and happier regions of the world? Do the men whom we see united in regular communities, directed by the same government, submitting to the same laws, and, even in the pursuit of their private interest, co-operating towards the general good, bear any affinity to the lawless and untractable nature of the wilderness? Are the benevolent schemes, which embrace in their object the happiness of millions, conceived by minds akin to those, whose ingenuity was never exercised but in plans of murder and devastation? Is the heart which knows no aim superior to the gratification of the lowest appetites, and the most odious passions,—which invests in its own grossness even the powers of heaven, whom it fancies the abettors of its lust and malignity,—of a common descent, and of a kindred nature, with his, who, spurning each low and sordid object, "exalts his generous aim to all diviner deeds,"—who, glowing with the inspiration of celestial love, beholds in all creatures the objects of the Creator's paternal regard, and rejoices in co-operating with the divine beneficence? Can the earth-bound soul, which scarcely darts a glance beyond the tomb, or which, through the mist of sensuality, seems to descry a country, where the unhallowed desires by which it is now agitated, shall riot in full enjoyment,—claim alliance with the heaven-born, heaven-aspiring spirit, whose thoughts, wandering through eternity, rejoice in the anticipation of its escape from the encumbrance of mortality, and of its perpetual progress in excellence and felicity? 

Yes! these natures, opposite as they appear, are formed originally after the same image. It is to education alone, that the civilized and enlightened man owes all his superiority. It is education, which, raising him above the degenerating dominion of sense, teaches him to respect the voice of reason, and to follow her as the guide of his conduct. It is education which reminds him of the necessity of subordination in regular communities; and which, convincing him how much the happiness of the individual is promoted and secured by submission to government and laws, expends even his selfish feelings into loyalty and patriotism. It is education which, leading him to reflect on the ties that unite him with friends, with kindred, and with the great family of mankind, makes his bosom glow with social tenderness, confirms the emotions of sympathy into habitual benevolence, imparts to him the elevating delight of rejoicing with those who rejoice, and if his means are not always adequate to the suggestions of his charity, soothes him, at least, with the melancholy pleasure of weeping with those, who weep: in a word, which renders even his self-love only a modification of generosity, and enables him to gather his purest bliss, from seeing others blest.

It is education, which, elevating his thoughts habitually to his Creator, gives constancy to his virtues amidst all the trials of life, and serenity to his mind amidst all its evils; which leads him to repose on the wisdom, the goodness, and the omnipotence of the Lord of the universe; and carries forward his views to the regions of immortality, where the apparent confusion and intricacy of the ways of Providence shall be unravelled into the most perfect order; and the toils, and struggles, and sufferings of persevering goodness, shall be rewarded with an eternity of unalloyed enjoyment.

Is this, then, a general and a faithful representation of the civilized and enlightened portion of our race? And do these happy effects invariably flow from a well-conducted education? Vices may prevail in the most refined and enlightened communities; but their vices are not the consequence of their knowledge and refinement. The most judicious system of education may be counteracted by unfavourable circumstances; but the failure is not chargeable on education. The excellence which we have described as the result of good education, has been attained by many; few are incapable of attaining it; and it is this capability which renders education an object of such inestimable importance, and such deep responsibility to all who have the charge of forming the human mind.

So great and so obvious is the influence of education in the development and direction of our moral and intellectual faculties, that many ingenious authors have ascribed to this cause alone all the varieties of human character. The great variety observable, however, in the external organization of infants, and the innumerable diversity of temper and capacities, which they display almost as soon as they are susceptible of any impressions, are objections to this theory in our opinion insuperable. The intimate connection between our physical and mental powers, and their mutual dependence, will make it impossible, we suspect, for the most attentive culture, to render human beings exactly alike, while nature continues to vary the structure and the sensibilities of their corporeal system. But though the influence of nature in diversifying the characters of men be great, the influence of education is still more remarkable. By the hand of nature, our organs of sensation may be formed lively or dull: to give efficacy to our actual sensations, is the part of education. Nature must bestow the sensibilities of our frame: by education, they may be excited or repressed. The powers of the mind are the
We know not what apology those parents can frame to their own minds, who can resign a charge so sacred, to the ignorance or indifferency of a hireling. Yet, whenever luxury has made any progress, it has been common for mothers, in affluent circumstances, to disregard so far the claims of affection, as to forego the pleasure of nursing their own children, or even of watching over them in the helpless years of infancy. To those who place all the happiness of life in the dissipation of perpetual amusements, and who persuade themselves that they were sent into this world merely to pass through it in the most easy and unthinking manner, it is in vain to represent the immorality of so unnatural an indifference. Yet, if every spark of feeling be not extinguished within them, they might, we should suppose, be led to ask their own hearts, whether they consult their happiness in thus resigning all the endearments of so tender a connection — whether all the varieties of that "tolling pleasure which sickens into pain," might not be well exchanged for the delight of cherishing so engaging a dependant; of seeing its cherub countenance brightening with the smile of reciprocal affection, receiving the caresses of its kindness and gratitude, and winding around its gentle heart the cords of indissoluble love? We might hope, that even a regard to their own future comfort would make them unwilling to allow their child to transfer those affections, which cannot easily be recalled, to the person whom they have engaged to perform to it the duties of a mother. But if none of these considerations can reclaim them from the selfishness of luxurious indulgence, and the unfeeling dissipation of fashion, let them at least do their child the justice to select for it a nurse, whose sound and healthy constitution may impart vigour to her charge; whose calm and patient temper may bear with all its wants and its cries, and save it from the fretfulness of perpetual irritation; whose conscientious integrity may be a substitute for maternal tenderness; and from whose language or manners it cannot contract no improper habits.

We all know, from experience, how much the vigour of our mental powers depends upon the state of our corporeal frame, and how much our thoughts and feelings may be influenced, how materially even our moral and intellectual character may be affected, by the external organs of the mind, and by the firmness or delicacy of our muscular and nervous system. The culture of our corporeal powers, therefore, considered as the instruments of our mental faculties, is entitled to the anxious attention of all who have the charge of a human being; and it is in the period of infancy that such attention will be most efficacious.

It is not our design to give such detailed and explicit directions for the management of children, as some writers have collected under the title of Physical Education; this would carry us far beyond the bounds which we have prescribed to ourselves for this article; and would, besides, be encroaching upon the province of medicine. Yet we may be allowed to suggest, in general, with the eloquent, though whimsical Rousseau, that, in the treatment of infants, it should be our endeavour to second and call forth nature, not to oppose her intentions and operations. Let not the infant, the moment he opens his eyes on the light, be wrapped in swathing bands, which restrain the freedom of motion essential to the growth and vigour of his limbs, and render even the internal parts of his frame incapable of their proper functions. Let him be frequently bathed in cold water, if he can bear it; but if he has been at first accustomed to the warm bath, let it gradually be made colder, till at length he be able to endure it perfectly cold. When the constitution, however, is weakly, or exhibits any phthisical tendencies, the cold bath cannot be employed with safety. Let the food of children be nourishing, but plain: their appetite, if neither pampered nor laid under unnatural restraint, will be the best guide as to the quantity that should be given them. When the weather permits, let infants be carried frequently abroad. The open air is peculiarly favourable to health; and the freshness, the beauty, the variety of the scenes of nature, impart, even in infancy, a serenity to the temper, and enliven and invigorate the powers of the mind. Healthy children, especially after they have learned to walk, will exercise themselves sufficiently if they are permitted; nor should they ever be restrained, during that period when their bodily vigour is the first concern. We are apt to adopt too many expedients to assist children, when beginning to walk: it is enough if we guard them from any dangers to which they might be exposed by their first efforts to move about. Neither should we be too anxious to preserve them from those slight hurts which they may incur, from their disposition to activity, before they have acquired sufficient caution or strength. Our excessive attention teaches them to confide in it, and to become careless of themselves; and while we seem to regard as a dreadful calamity every trifling accident that may befall them, we are forming habits of timidity and effeminacy, of which they may find it difficult or impossible to divest themselves in future life.
Let it never be forgotten, that, even in the earliest period of infancy, children are acquiring those habits which are to determine their future character, and to influence their future happiness. It becomes, therefore, of the last importance, so to regulate their associations, that their desires and partialities may be directed only towards what is useful or good; and that aversions and dislikes towards what is bad or pernicious. The effect of example is here omnipotent. Children are the creatures of imitation, and adopt implicitly the manners and the sentiments of those under whose protection and influence providence has placed them. This imposes on every parent a sacred obligation to weigh well the motives which actuate his own conduct, and anxiously to examine the temper and dispositions of his own mind. A child necessarily connects the idea of good with that object towards which he sees the desires of his parents, or his elders, invariably pointed; and with the objects of their aversion, he as necessarily associates the idea of evil. By the silent instruction of example, therefore, even before they have learned to articulate our language, we may be forming them to virtuous conduct, and inspiring them with benevolent affections. It is a fatal mistake to suppose that children are at any time too young to be contaminated by the contagion of evil example. Long before they can question us with regard to our motives, they are accurate observers of our actions, which, whether good or bad, they are ever prone to imitate. Let us always act before them, therefore, with that reverence, which, as the poet reminds us, is due to a child; and exhibit, in their presence, the qualities which we wish them to acquire, in such a manner as to tempt their imitation. Even their intellectual improvement may be promoted in no small degree by the aid of this useful principle. Through their proneness to imitation, excited and cherished by their anxiety to please those who have gained their affection, much useful information may be conveyed to them, without the formality of direct instruction, and without repressing that sprightly gaiety which distinguishes this innocent and unclouded period of life. From this principle, likewise, parental authority derives much support. The habit of implicit submission is of the utmost consequence to the improvement of a child; and it is but fair that they should be convinced, that we require of them nothing which we are ourselves unwilling to perform. To the command of a parent, thus seconded by his example, they will submit with the same implicit resignation as to the laws of nature. How far the restraint of parental authority should be imposed, it is not easy to prescribe: but it may be laid down as an invariable maxim, that it should never be allowed to yield to any resistance or remonstrance on the part of the child. At a very early age they are capable of reasoning and of moral distinctions, and are therefore proper subjects of authority; while at the same time they are so feeble, so inexperienced, so ignorant of the powers and qualities of surrounding objects, and of the language, the manners, and the arts of men, and of course so incapable of supporting or conducting themselves without direction and assistance, that the habit of ready and full obedience is essentially necessary to their safety and their welfare. It may not be always proper to explain the reasons for which their obedience is required; for, while the range of their ideas is less extensive than ours—while they are yet unacquainted with our language, and cannot understand our reasoning—we may be unable to make them comprehend the causes of our restraining them, or to convince them of their propriety. With one conviction, however, we should endeavour at all times to impress them,—the conviction that we impose no restraint but from affection to themselves, and to promote their advantage. For the direction of parents and guardians in the management of children during infancy, we beg leave to refer them to the excellent treatises of Miss Hamilton, Miss Hannah More, and Miss Edgeworth, on the subject of education; and shall in the mean time content ourselves with observing, that the grand objects of attention during this important period, should be, to subdue the malevolent, and to foster the benevolent affections; to counteract all unreasonable aversions and antipathies; to correct extravagant partialities; and to regulate all the active principles of their nature, so as to prepare them for engaging, with vigour and success, in the studies and occupations of the succeeding stages of life.

At what age it may be proper to fix the attention of children to regular tasks, and to begin to teach them to read, it is not easy to determine. So much must depend on the health, the articulation, and the apprehension of children, that the discretion of the judicious parent or guardian will be, in this respect, the best guide. Perhaps it might be proper to make them familiar with their alphabet as soon as they can articulate distinctly. But learning must approach them at first in the most alluring form. Let them not be confined to their task till it become tiresome and disgusting; nor be subjected to any harshness, severity, or restraint. When they have been accustomed, for some time, to this gentle exercise of attention, we may venture to require of them a more regular and steady application during a stated portion of time. The quickness of apprehension, and tenacity of memory, which children display at a very early period, enable them to acquire, without much difficulty, the art of reading. When the pupil has learned to read with considerable facility, he may with propriety be taught the first principles of grammar. To name and define the different parts of speech, will at first be all that can well be expected of him; but when, by practice in parsing, he has acquired a sufficient knowledge of these, he may then be initiated in the syntax of the language, and taught the principles on which the construction of sentences depends. This will be an admirable exercise for his understanding and his ingenuity; and will prepare him for entering, with peculiar advantage, on the study of any other languages, to which his attention may afterwards be directed. We have sometimes been highly gratified by seeing children, under the tuition of an able English teacher, parsing and constructing any passage that was presented to them, with all the readiness and precision which we had been accustomed to expect only from classical scholars. Important as this acquisition is in itself, the habits of steady attention, quick apprehension, and accurate discrimination, which it necessarily imparts, are still more valuable.

This is the proper time, likewise, for storing the pupil's memory with such passages from the most approved writers, particularly the poets, as may at once captivate his fancy, enlarge his comprehension, and improve his morals. Though he should not be able to perceive at first all the beauties which these passages contain, they will still afford him instruction, if not pleasure; they will recur spontaneously to his recollection in his hours of solitary recreation; and he will be led, as his judgment matures, to appreciate their
E D U C A T I O N.

This, too, is the period, when he should be made acquainted with the relation in which he stands to his Maker and to mankind; with the obligations of morality and the duties of religion. In communicating this branch of instruction, we are aware that much caution and judgment are necessary. It is so difficult for children to form any proper notions of the uncreated Sovereign of the Universe, that we should perhaps allow their faculties to have advanced far towards maturity, before we attempt to explain to them the nature of God, or the sublime tenets of the Christian faith. Yet their hearts are, at a very early period, susceptible of religious impressions; and though it may not be proper to speak to them of the incomprehensible attributes of God, we see no harm, but we think many advantages which might result from teaching them, even from the dawn of reason, to regard him as the Creator, not of themselves alone, but of the whole human race; to refer to him all their comforts; to look up to him as the inspector of all their actions; and to cherish the sentiments of love, and gratitude, and submission, which these considerations are fitted to inspire. In the mean time, these religious impressions must be aided and confirmed by the uniform tenour of our own example. Let us shew them our reverence for piety and virtue; let them often listen to us, while we discourse, though not directly to themselves, of the existence of a Being, who is the creator, preserver, and governor of the world; let us speak of the constant dependence of all creatures on the gracious care of their Creator; let us descant, with ardour, on the gratitude and obedience which we owe to him, as our Great Parent and unwearied Benefactor. From such discourses, well-timed and properly conducted, they will catch insensibly the glow of piety, and will be prepared for a fuller explanation of the great doc trines of religion.

There is one caution which we would most earnestly enjoin with regard to the religious education of children. Let religion be associated in their untainted minds, only with what is lovely, cheerful, and inviting. Let her never assume the frown of austerity, or be armed with the terrors of vengeance. Let her never be ushered in as an unwelcome intruder upon their innocent joys; nor, even in the moment of transgression, let their hearts be appalled by the dread of her unrelenting severity. Let her speak to them only in the accents of gentleness, and captivate them with the smile of benignity. Let them be taught to regard her as their best friend; rejoicing in their happiness; interested in their welfare; and watching with tender affection over their progress in wisdom and virtue. Let them learn to regard the duties which she enjoins, not as irksome restraints, from which they would be glad to escape, but as directions which have no end in view but their own advantage, and with which it should be their delight, as it is their privilege, to comply. Let her sometimes be admitted to their parties of pleasure; but let it only be to give zest to their enjoyments, and to heighten, while she refines, the native gaiety of their hearts.

Whoever has considered the influence of early associations, will at once admit the propriety of connecting religion in the youthful mind with the most pleasing ideas, and the most grateful recollections. Who has not experienced the power of association in biasing the affections, and determining the conduct, even in opposition to the plainest dictates of reason, and the decided conviction of the understanding? Who has not felt his heart revolt against persons and objects, which his sober reason represented as in all respects estimable, merely because they had at first been connected in his imagination with something unpleasant or unlovely? Who has not seen their adoption of the most pious and exemplary parents, when they came to be the masters of their own conduct, exulting in their emancipation from the restraints of religion, triumphing in the sophistry of scepticism, and plunging with eagerness into the depths of vice and profanity? What could there be in that religion, which speaks peace and goodwill to the children of men, which breathes a spirit of universal benevolence, which unites earth with heaven in the bond of mutual love, which opens every avenue to happiness in the human heart, and fortifies it against every evil,—what could there be in such a religion, to excite their aversion, and make the escape from its influence appear so happy a deliverance? Alas! it was not the religion of Jesus which they were taught: it was a religion obscured by prejudices, and clouded by fears, which the Saviour of the world would disclaim! a religion, in which the malignity of human passions mingled with divine goodness, and the voice of mercy was lost in the voice of accusation and of vengeance. Their obedience to this religion was founded on the most degrading principle in their nature, the principle of fear; and all the duties which it enjoined were regarded as so many restraints, which inclination must resist, and which reason did not sanction, but which, as the unquestionable mandates of divine authority, a regard to their own safety rendered it necessary to comply. Is it wonderful, then, that they should be impatient of a religion connected in their minds only with the most painful associations; that they should eagerly embrace the first opportunity of recovering their native freedom of action; and, instead of raising their minds in habitual devotion to their Heavenly Father, should endeavour to escape from the recollection of a Being, whom they had been accustomed to regard as a relentless and avenging tyrant, the enemy of every social joy?

But is religion, it may be asked, a system of unlimited indulgence? Does it impose no restraints on our evil passions? Does it denounce no punishments against transgressors? Does it not speak of the justice as well as of the clemency of God; and does it not deter us from sin by the dread of his wrath, as well as allure us to virtue by the hope of his favour? Unquestionably. To creatures imperfect as we are, a system which recommends unsullied purity in thought, word, and deed, must certainly be a system of restraint. Punishments, dreadful in magnitude and duration, are denounced against the obstinate offender; and the same voice that proclaimed from heaven the tender mercies and long-suffering of God, proclaimed likewise that justice which can by no means clear the guilty. But is there any tinge in all this inconsistent with that character in which the Almighty delights to be represented,—the character of a gracious sovereign, an affectionate parent, an unceasing benefactor? Parental authority, even in its mildest form, must certainly be a species of restraint, while the propensities and passions of children require to be controlled or subdued. It is not restraint, but the mode of imposing it, from which the human heart revolt. Once convince a child of the unbounded kindness of a parent, and of his solicitude, even while he forbids or...
thwarts, to promote his dearest interests, and to multiply his enjoyments, and there is no species of self-de\n\nduct which he will not account happiness, compared with the evil of incurring his displeasure.

On the same principles of respect, affection, and gra\ntitude, must religious obedience be founded. "Thou shalt love the Lord thy God," said our Saviour, "with all thy heart, with all thy soul, and with all thy strength. This is the first and great commandment."

Let it be our endeavour to prepare the hearts of our children for this ardent love, by accentuating their tendency to please, by cheerful obedience, so affectionate a guardian, protector, and friend! How dreadful an evil will it appear to incur his displeasure? How unpar\ndonable a crime to requite his goodness with ingrati\ntude and disobedience! When the youthful breast is thus occupied with love to God, it will not be difficult to make it ex\npand in benevolence to all the human race, the family of the same Heavenly Father. "The love of God," says the excellent Miss Hamilton, to whose work on education we have already referred, "is the purest, the most sublime emotion of which the heart is capable, must, from the very nature of the human soul, result in purify its affections, preparing it for the exercise of those generous sympathies that flow from unbounded benevolence. When the first conceptions of the Deity have tended to expand the heart with grati\ntude and love, every additional step in the knowledge of his attributes, every new light thrown on 'the mys\ntery that was hid for ages,' but now displayed in the Gospel of Jesus Christ, will add force to these sen\ments, and inspire a deeper humility, and a more pro\found veneration. With such feelings, no selfish or vindictive passions can possibly mingle. By true piety, no such passions can possibly be produced. From whatever has a tendency to inspire these passions, un\nder whatever imposing form it may appear, I would endeavour to preserve the infant mind; and therefore, instead of warming the infant heart with zeal for any dogma that may be the object of veneration to myself or my party, I would present it as a sacrifice to Him, who fills heaven and earth with the majesty of his glo\ry, and, by the idea of one common Father, connect it in affection with the wide circle of the human race."

We cannot quit this interesting subject without ob\erving, that all our endeavours to impress our children with proper sentiments of religion will be unavailing, unless we shew, in all our conduct, a consistent regard for whatever is sacred; a reverence for pious and good men; in whatever station they may be placed; and a marked disapprobation of vice and irreligion, however imposing the form in which they may appear. While we enjoin on our young pupils a respect for the ordi\nances of religion, let us beware of countering the in\junction by a marked contempt, or habitual neglect of them. While we exhort them to aspire to piety and virtue, as the only estimable possessions, let them not be tempted to question our sincerity, by seeing us fixing our esteem and affections on possessions of a very different kind. While we express our abhorrence of vice and profanity, let us not taint their moral atmos\sphere by the contagion of our impurity. While we endeavour to direct their natural love of praise to its legitimate gratification; while we teach them to hope for distinction only by superior worth, and to prize, above all other fame, the approbation of the wise and the good,—let us never be seen bestowing our own admiration on the trifling distinctions of wealth, or rank, or even talents unaliued to virtue; let us be seen uniformly respecting excellence, however obscured by poverty; and disclaiming all intercourse with bad men, however they may bask in prosperity, or be encircled in the dazzling glare of dignity and fashion.

We find that we have been carried away by the import\nance of our subject, far beyond the bounds which we had prescribed to ourselves in entering upon it. Yet we must still crave the indulgence of our readers, while we express our opinion of the usual modes of imparting reli\gious instruction to children. These modes, we fear, are but ill adapted to the great end which they have in view. It is not by loading the memory of a child with tedious catechisms, comprehending a whole system of divinity, that you will either enlighten his mind with any proper ideas of his Creator, or raise his heart to\wards him in the glow of spontaneous devotion. As formal instruction, however, may be necessary, it might be extremely useful to have a short and simple cate\chism, which might be easily committed to memory, and which should contain only those leading truths of religion, to which the attention of a child may with prop\erty be directed. One great advantage of such a catechism would be, that, to parents, whose time or oppor\tunities do not allow them to frame a plan for themselves, it would serve as a valuable guide in this important department of education.

But it is to the scriptures that we must teach them chiefly to look for direction in moral and religious duty. Reading the scriptures, impressing them with deep reverence for the sacred writings, as the revelation of their heavenly Father's will, let us teach them to regard it as their greatest privilege, and their indispensable duty, to peruse a cer\tain portion of them daily, and with becoming atten\tion. At first, it will be proper to confine them to the simple but interesting narratives of the Old Testa\ment; to the life, the miracles, and the precepts of Je\sus, recorded in the Gospels; and to the delightful and animating effusions of devotion in the book of Psalms.

To insure regularity in their study of the scriptures, we would be disposed to recommend, that a stated portion of each day should be devoted to this employment. One evil, however, to be dreaded in this case, would be, that they might regard an employment recurring so reg\ularly as an irksome task; and we think it would be a most important point gained, to accustom them to look forward to the reading of the scriptures as the re-
ward of good conduct, rather than to associate with it any idea of compulsion. We are quite convinced, that the aversion which many persons, who have been piously educated, have afterwards shewn to the sacred volume, has been occasioned more frequently by the injudicious manner in which the task of reading it has been imposed upon them in their early years, than by any other cause. Surely it is possible to excite and to preserve in youth, such a relish for the inspired writings, that they shall read them with as much pleasure as any productions of human genius. One effectual way of guarding them against any dislike at least, to the scriptures, is to train them, even in the most ordinary, and apparently trivial, parts of education, to those dispositions and habits which the scriptures require. If we have never taught them to subdue their passions, and to restrain their desires, we cannot wonder if they should revolt from those lessons of sobriety which the gospel delivers, and that spirit of self-denial which it demands. If they have not been trained to ready obedience to their parents and superiors, they will be but ill prepared for that unreserved submission to their Heavenly Sovereign which revelation enjoins. If they have been encouraged in the idea of their own importance, and taught to expect, that every thing must bend to their pleasure, they will scorn the humility, meekness, and patience, in short, all the graces and virtues which are required as the distinguishing marks of the follower of Jesus. They will, of course, never open, but with reluctance, the sacred code, in which they can read only their own condemnation; which requires a spirit which they have never cultivated, and prescribes duties for which their hearts are not prepared. If, therefore, we would have our children religious, let us begin with cherishing within them, from their earliest infancy, those affections and tendencies which religion requires, and training them to those virtues which religion prescribes. Thus, when they come to study the record of the divine will, they will be delighted to find how much it harmonizes with their own feelings, and how easy their advances in the "way of God's commandments" are rendered, by the progress which they have already made. Against persons thus gradually prepared for the reception of the doctrines and precepts of religion, all the arts of the infidel will be practised in vain. Even the allurements of temptation will not unseat the principles of those, whose feelings are all engaged on the side of religion; and amidst all the storms and agitations of life, that hope, which is the anchor of the soul, will secure them from making shipwreck of their faith.

When children have learned to read with fluency, the curiosity natural to their age, and the equally natural pleasure of exercising their newly acquired powers, will probably induce them to read with avidity any books with which they may be furnished, that are not beyond the reach of their comprehension. To supply them with the most proper books for engaging their attention, and improving their minds, becomes, therefore, an object of the greatest importance. Amidst the infinite variety of books which have recently been published for the use of the rising generation, the principal difficulty is to select those which may at once afford them present amusement, invigorate their mental powers, and confirm, while they direct, their taste for reading. Many writers, wishing to accommodate themselves to the capacity of the youngest children, have published more childish nonsense than the merest infant was ever known to utter: others, by way of conveying to them very useful information, have penned for their instruction a number of those obvious facts, which every baby knows before it has learned to articulate; such as, "that is the fire—the first you see, is red, and it is hot; for if you touch it, it will burn you," &c. Such contemptible productions are calculated, not to improve, scarcely even to please children; but only to perpetuate their infancy, and to give their minds a frivolous turn, which may unhappily characterize them through life. The books which will most captivate their fancy, and at the same time impart the most useful instruction of which they are yet capable, will be those which describe the more common actions and characters of men, the scenes of external nature, the properties of material objects, the forms and tempers of animals, and whatever either at present exercises their active powers, or can open up to them a new sphere of employment. We ought particularly to endeavour so to regulate their reading, as to point their curiosity to those objects which are soon to occupy their more serious attention, and to prepare them for engaging with eagerness and with advantage in their future studies. Were we to recommend any books for children, where there is such variety of choice, we know none which we would prefer to the "Children's Friend," and "Evenings at Home,"—productions so generally known, that to have mentioned them is sufficient.

When our pupil has acquired a due facility in reading his own language, and a competent knowledge of its grammar, it will be proper, if we are to allow him the advantages of a classical education, to engage him in the study of Latin. The acquisition of classical literature is a very important part of a liberal education. We believe we may safely hazard the assertion, that those who have denied the advantages of an acquaintance with the languages of ancient Greece and Rome, have, with the single exception, perhaps, of Mr Locke, been men whose classical education had either been entirely neglected, or at least had not been prosecuted so far as to enable them to estimate, from their own experience, the value of the acquisition. Nor does even Mr Locke forbid that a certain share of attention should be given, in the education of a gentleman, to the study of Latin; while he admits the necessity of an intimate acquaintance with both Latin and Greek to those who are to follow any of the learned professions. Classical knowledge, if pursued as an ultimate object, is, we own, of very inferior importance to those sciences which explain the properties of matter and of mind, which multiply the resources of man, and invest him with new powers; and, perhaps, Mr Locke might have seen men who knew the classics, and knew nothing more; who would dwell with enthusiasm on the sublimities of Homer, and the subtleties of Aristotle, while they were incapable of appreciating the still higher sublimity of the discoveries of Newton, or the profound speculations and acute reasoning displayed in the Essay on the Human Understanding. Such instances might have led him, with a partiality of judgment unworthy such a philosopher, to ascribe to the study evils which resulted only from the absurd mistake of making that study a principal or exclusive object;—while he rather ungratefully forgot the benefit which he himself, with a long series of great and learned men, whose names adorn the annals of our country, had derived from a regular classical education.

We do not know that any objections have been urged against the study of the polished languages of anti-
The question, which have not arisen out of the same mistake that induced Mr Locke—not to reprove that study, but to undervalue it. If it be said that the time spent in acquiring these languages might be more profitably employed; we admit the validity of the objection, if the scholar's attention is to be confined merely to words, or if to construe the sentences of a Greek or Roman author, is to be the amount of his attainments. But while he is engaged in the study of the classics, he is, if properly taught, acquiring a more perfect knowledge of the principles of grammar, than he could have attained in any other way; while he analyses compound words, traces back an expression through all the steps of its progress, from its simple and contracted, to its figurative and more extended meaning, and explores in the history or institutions of antiquity, the origin of particular phrases and idioms; he is forming habits of accurate discrimination, gaining insensibly a knowledge of some of the most interesting operations of the human mind, and storing his memory with many important facts in the natural and moral history of man.

If it be said, that a knowledge of the ancient authors is apt to engender pedantry, the same objection may be made to any study which is calculated to give us the least appearance of superiority, particularly if pursued with any degree of enthusiasm; and we fancy we can discover at least as much pedantry in those who quote Rousseau or Madame de Stahl, or who quote modern sentimental poetry, as in the classical student, who edifies his company with a precious sentence from Plato or Cicero; or with the rich and melodious strains of Horace and Pindar. Of the latter species of pedantry, however, there is but little danger. Classical learning furnishes few topics for common conversation; and scholars have in general too much sense to exhibit their treasures where they cannot be appreciated. The pedantry with which we are most frequently annoyed, is the pedantry of those, who, having by some unlucky chance picked up a few of the facts or allusions contained in the writers of antiquity, are producing them on all occasions, to show the extent of their classical lore.

A more formidable objection has been urged against a classical education, as tending to corrupt the minds of the young, and to lower the tone of their moral feelings, by rendering them familiar with the gross vanities of the Heathens, and the licentious effusions of their poets; and by directing their admiration towards heroes and sages, whose conduct and whose principles were, in many respects, at variance with the pure and gentle spirit of Christianity. "However," it has been said, "the study of the classics may have opened the understanding, enlarged the views, and elevated the sentiments of men, it is to be feared that many prejudices have flowed from the same source, which are inconsistent with the spirit of the religion which we profess; prejudices that are inimical to that spirit, at variance with the whole tenor of our Saviour's precepts, and the cause of a perpetual and manifest inconsistency between the practice and profession of Christians. These prejudices have thrown a shade of ignominy over the mild glories of humility, meekness, and mercy; and exalted pride and revenge into the rank of virtues. They have substituted the love of glory for the love of truth; emblazoned the crimes of ambition with the lustre of renown, and taught men to prefer the applause of a giddy multitude to the approbation of God. By introducing false associations of regard and preference, with adventitious circumstances altogether foreign to the moral character, as learning, strength, valour, power, &c. they have destroyed the just criterion of human worth, and given to situation, which marks the nature of the duty to be performed, that respect which is morally due to the just performance of duty. They have gratified the pride of man at the expense of his virtue." Were these the necessary or the probable effects of the study of ancient literature, we can conceive no advantages by which they could possibly be compensated. But the charge, if not altogether groundless, is certainly much broader than facts will support. We shall admit, that there are many very exceptionable passages in the captivating poems of antiquity; that the ancient heroes possessed many qualities worthy of reprobation; and that the ancient philosophers held opinions, and enjoined practices, altogether repugnant to the spirit and doctrines of revealed religion. But are our own poets, or, indeed, the poets of any nation, more distinguished for their purity? Do our own histories record deeds more elevating, or delineate characters more perfect? Nay, are the works even of our philosophers less chargeable with error, or less exceptionable in morality? The indiscriminate perusal of the classics would certainly be pernicious:—would not the indiscriminate perusal of English authors be equally hurtful? Would you deny your pupil the privilege of reading his own language, because there are English books of an immoral tendency? Would you lock up from him the history of his own country, because, with the virtues which will command his admiration, are connected qualities, which it would be improper to imitate? Would you debar him from the regions of philosophy, because, while pursuing the road to truth, he may occasionally be tempted into the paths of error? or because, amidst the fruits and flowers by which, every step he advances, he is charmed and invigorated, there may be some that bloom but to deceive, that allure but to destroy? The teacher of the classics, as well as the teacher of English, has the power of selection; and where, except in the sacred volume, can be found finer precepts of morality, recommended by more captivating elegance, than in the writings of the poets and philosophers of ancient Greece and Rome? where can be found deeds of nobler generosity, of more magnanimous heroism, of sublimer virtue, than the ancient historians record? Let every teacher impress on the minds of his pupils a deep respect for revelation, and acustom them to refer, on all occasions, to the Divine law as the standard of morality. Thus directed, they may expati ate with safety over classic ground; nor can there be a more delightful, or more improving exercise, than to trace the various systems of the ancient sages, and while we mark the approaches of human wisdom and virtue towards the perfect system of the gospel, to gather new materials for gratitude to the Divine goodness, which has revealed, even to the most simple, those important relations and duties which the wisest men, in the most enlightened nations, were unable to discover. Even Mr Locke recommends that, in the education of a gentleman, Cicero's Tressise De Officiis should be studied along with the Bible, as his best guide in the science of ethics.

But supposing no particular evil to accrue from the study of the classics, what advantages does it promise of a classical education? To some of these advantages we have already adverted; to enumerate them all would require more time, and fuller detail, than we can at present afford. Every classical scholar knows, how essentially a know-
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In ancient times, before the revival of literature, the languages of modern Europe were rude and barbarous; and when the study of the perfect models of antiquity introduced a taste for elegant composition, men of genius, renouncing their own uncouth and untractable languages, adopted the Latin, by general consent, as the medium of all their communications. Their example soon diffused an universal predilection for a language, which was thus made the vehicle of all valuable information. Latin became the language, not of literature alone, but of business; and to persons of both sexes, and of every rank, the knowledge of it became nearly as necessary as that of their vernacular tongue. One happy effect of their intimate acquaintance with this elegant language was, that it improved and enriched their own. They learned from it to express ideas, for which they had formerly no adequate signs; they transferred from it, of course, many words into their native dialect, where they soon became naturalized. Thus more than one half of the English language is of Latin origin; and who ever wishes to study it with precision, will find a knowledge of Latin indispensably necessary to enable him to ascertain the full force of many of the most familiar words, by tracing them back to the root from which they spring.

For the same reason, it is evident, that a knowledge of the classics is the best key to all the modern languages. The facility with which a person who has had a classical education acquires any modern language, is to those who have not enjoyed that advantage, almost inconceivable. Thoroughly versed in all the principles of grammar, he soon becomes master of those peculiarities by which the grammar of any particular language is distinguished; and in studying any of the modern tongues, he finds that his knowledge of Latin has already put him in possession of half its vocabulary.

But it was not only by the addition of new words that the classical languages of antiquity contributed to the improvement of those of modern Europe. They whose ears had been accustomed to the melodious terminations of Greek and Roman words, and to the harmonious construction of which they are susceptible, could not endure the harshness and dissonance of their native jargon. Yet the intercourse of life would often require that they should speak in the language of their country, and the patriotic desire of benefiting even the lowest of their countrymen by useful instruction, would induce them sometimes to employ it in their compositions. Thus obliged to retain their vernacular tongue, they found it necessary, for their own convenience, to smooth its asperities, and to correct its irregularities, till acquiring a partiality for what they were daily contributing to improve, they conceived the lamentable imitation of raising it from barbarism, to vie in elegance, precision, and vigour, with the noble languages of antiquity. Whoever will look back a few centuries, to contrast the language of his ancestors, fit only for the intercourse of savages, with the language in which Johnson has written, in which Burke has spoken, and Pope has sung, will have some idea of the extent of our obligation to the admirable productions of ancient Greece and Rome. From them were drawn the treasures by which our own language has been enriched; in them were contemplated the models according to which it has been improved; with them we must have an extensive acquaintance, before we acquire the full command of our vocabulary, or understand the philosophy of our own grammar; and the study of these classical works will be our best security against the corruption of the language, which they have so wonderfully improved.

The principal value of all education, however, arises from the exercise which it gives to the faculties of the mind, and from the habits which it has a tendency to form. In this respect we think classical education particularly, we would almost say peculiarly, valuable. No department of education gives such exercise to the memory, the judgment, the imagination, and all the mental powers, as the study of the ancient languages. Even the first elements of these languages cannot be acquired without such a patient exertion of memory, as must contribute essentially to improve it in readiness and retention; and the frequent repetitions that are required throughout the whole course of classical discipline, form the habit of industrious application, while they store the mind with the most valuable treasures. For imparting precision of thought and accuracy of discrimination, no employment which we know can be more useful, than to mark the distinction between words apparently the same in signification; nor can any means, perhaps, be more effectual for enlarging the understanding and quickening ingenuity, than to trace back expressions to the substances and qualities in nature which they are used to represent, or the peculiarities of thought in which they have originated, to compare the idioms of different languages, and explore the general laws of their analogy and construction.

The utility of classical literature, in cultivating the imagination and refining the taste, has never been denied. Whatever partiality men may have entertained for the writings of their own country or age, all have been willing to acknowledge the advantage of studying those splendid monuments of genius, which the ancients have bequeathed to posterity, and which, through many centuries, have been contemplated with unabated admiration. The only dispute on this point has been, whether the moderns have not already so far improved by these models, as to have attained nearly equal excellence; and whether the fine specimens which our own language affords of every kind of composition, may not be sufficient to form the taste of the present and of future generations, without leading them back to their prototypes, through the perplexed and toilsome paths of languages long discarded. High as our admiration of antiquity is, we are far from wishing to deny the merit of the classical productions of our own times, or to assert that no excellence in composition may be attained, without being conversant with the philosophers, the historians, and the poets of Greece and Rome. Works of much genius, and of considerable elegance, have, we know, been produced by some who had not the advantage of a classical education; but let it not be forgotten, that the beauties which they could not contemplate in the original, they still admired and admired, though perhaps with diminished charms, in the writings of those whose genius they had elevated, and whose taste they had refined; and if, even in the pages of Franklin and of Burns, we can occasionally discover some approaches to rudeness, we may perhaps, without rashness, conclude, that, in composition as in the other fine arts, perfection of style can only be attained by studying the genuine productions of the great masters of antiquity. This, at least, is certain, that, among modern authors, there will not be found one entitled to the rank of a classic, whose mind was not deeply imbued with ancient literature, and whose genius was not elevated and chastened by the habitual
contemplation of those pure and exalted standards which were produced in the flourishing days of Greece and Rome. It is thus that we recognise in the "Paradise Lost," the fire and sublimity of the Maenad bard; that the "Pleasures of the Imagination" recall to us the sonorous harmony of Lucretius, the lofty conceptions, and the magnificent eloquence of Plato; that the "Seasons" delight us with the same beauty of description, the same rural elegance, the same discursive fancy, which we admire in the Mantuan swain; that in the enchanting verses of Pope and of Campbell, we see removed that extreme felicity of expression, that magic melody of numbers, that delicacy of sentiment, and graceful ease of manner, for which the poems of Horace have been so justly admired; that the pages of Addison reflect the sweet but simple grace of the "Memorabilia"; and that our three great historians have restored to narration, the beauty, the dignity, and the animation, which impart such interest to the histories of Herodotus, Thucydides, Xenophon, Livy, Tacitus, and Sallust. It were of itself a sufficient recommendation of classical learning, that our admirable countryman, Dr. Robertson, when visiting, as Principal, one of the literary classes of the University of Edinburgh, declared, for the encouragement of the young men in the prosecution of their studies, that if he had acquired any fame as a historian, he owed it entirely to his acquaintance with the historians of antiquity. "To all such then," we borrow the words of Dr. Blair, "as wish to form their taste, and nourish their genius, let us warmly recommend the assiduous study of the ancient classics, both Greek and Roman:"

Nocturna versus manu, versus diurna.

Without a considerable acquaintance with them, no man can be reckoned a polite scholar, and he will want many assistances for writing and speaking well, which the knowledge of such authors would afford him. Any one has great reason to suspect his own taste, who receives little or no pleasure from the perusal of writings, which so many ages and nations have consented in holding up as objects of admiration. And it will be found, that in proportion as the ancients are generally studied and admired, or are unknown and disregarded in any country, good taste and good composition will flourish or decline."

Great, however, as, in our estimation, the advantages of classical acquirements are, we are far from wishing that, in any stage of education, they should be the sole object of attention. The enthusiasm of pedants, who maintain that every thing valuable in knowledge is contained in the treasures of ancient literature, and the absurd custom which that enthusiasm has established in many of our public seminaries, of making the ancient languages, for seven or eight years, the exclusive study of youth, have done more, perhaps, than any other cause, to retard the progress of science, and to bring classical learning into discredit. Even where the partiality to the Greek and Roman languages is less extravagant, we are afraid that a very undue proportion of time and attention is devoted to them. Aware as we are of the difficulty of acquiring these languages, we maintain, and we are supported by experience in maintaining, that at least one half of the time usually spent in studying them, might, without retarding the progress of the pupil, be saved for the acquisition of other branches of knowledge. The attention, when exercised long upon one subject, becomes fatigued and languid; and it is not the least important, or the least difficult duty of those to whom the education of youth is entrusted, so to regulate their studies, that in the hours of labour, their minds may be kept on the stretch, without being overstrained, and that every moment employed in business may be employed to advantage. With two hours a-day of assiduous preparation, and an equal portion of time spent under the direction of an able teacher, a boy of ordinary capacity would, we are confident, advance more rapidly in knowledge, than if he were doomed to drudge eight or ten hours daily at the same study. This would leave a great proportion of his time vacant for other studies; and would thus remove one of the strongest objections which have been urged against a classical education.

But though it would be wrong to confine the pupil's attention exclusively to the classics, to distract it with too great a variety of objects would be still more improper. A change of subject is always a relief to the mind; but if the subject be too often changed, the attention will become unsteady, and the memory will be bewildered. Neither ought the different subjects of study to be entirely homogeneous. A person who is engaged with two or three subjects of a similar nature, will be more apt to be confused, than one whose attention is occupied with a greater number of objects perfectly distinct. Thus, whoever has attempted to learn several languages at the same time, must have found, that while his memory was perpetually confounding them, each was an incumbrance to retard his progress in the other.

In varying the studies of our pupils, we should endeavour to adapt them, as much as possible, to the different powers of the mind, that they may all be invigorated by their proper exercise. With the study of language, which improves the memory, let arithmetic be joined, which affords more exercise to the reasoning powers, than any branch of learning to which the attention of a child can be directed. An early and accurate acquaintance with arithmetical notation and numeration, is peculiarly calculated to impart habits of precision, arrangement, and classification. Notation, originating in the operation of necessity or the powers of the human mind, is an object worthy of the attention of the philosopher; while, at the same time, from its distinctness and simplicity, it serves as a most important exercise to the juvenile understanding. Arithmetic, according to the usual modes of teaching it, is little more, indeed, than an exercise of memory; but, if taught judiciously, with a constant reference to the principles on which its rules are founded, it will contribute more than any other department of early education, to the vigour and acuteness of the powers of the understanding, and will give a tendency to order and method, which will be of the most essential importance in every mental operation. To the teacher who wishes to make the rules of arithmetic conducive to the improvement of the reasoning powers, there cannot be a more valuable assistant than a little posthumous work of Condorcet, entitled, Moyen d'apprendre a Comptar Soinamment et avec Facileite. The first thing, as the French author justly remarks, in the elements of arithmetic, is, that they are, at the same time, the elements of the art of reasoning. By a clear explanation of the principles on which every rule is founded, the learner is prepared for that which is to succeed it; and, when he has attained to the utmost height of the science, he sees, by one retrospective glance, the successive steps by which he has been conducted. Thus, while he acquires a precision in his operations, which
no other method could impart, his judgment is cultivated; he learns to form distinct ideas; and commences those intellectual habits which are subservient to the highest attainments of knowledge, and to the best conduct of life. This valuable work, which was long unknown, or strangely overlooked in this country, has been lately translated into English by Mr Elias Johnston, teacher of writing and mathematics in Edinburgh. See Connoctet.

When our pupil has acquired a competent knowledge of the principles of arithmetic, he may proceed to the study of algebra, which possesses nearly the same advantages, and, along with them, others conducive to a still higher degree of mental culture. The study of algebra counts the powers, invention, and combination; it accustoms the mind to general reasoning, while at the same time it leaves it at liberty to check and correct that reasoning at every step.

Geography. About this time, or even along with the study of arithmetic, geography may with propriety be made an object of attention. Were it only as an exercise of memory, and as subsidiary to the knowledge of history, the study of geography would be highly valuable. It is valuable, too, as it forms the habit of arrangement, and of associating names with the objects of which they are the signs. But it is chiefly valuable, because it is the proper vehicle for many important topics of information; and, by leading the mind beyond the narrow sphere of its own observation, it enlarges its comprehension, and weakens its prejudices, and forms an interesting link between mere sensation and abstract speculation. The plan which Rousseau proposes for imparting a knowledge of the relative motions of the sun and the planets, is extremely judicious. "The earth," says he, "which we inhabit, and the sun, by whose beams we are enlightened, are the first objects which claim our attention. We will therefore direct the attention of our pupil to the phenomena of nature. We will lead him out, on some beautiful evening, to behold the setting sun. Here we take particular notice of such objects as mark the place of his going down. Next morning, we visit the spot, to contemplate the rising of the glorious luminary. After contemplating for some time the successive appearances which the scene before us assumes, and making Emilius observe the hills and the other surrounding objects, I stand silent a few moments, affecting to be occupied in deep meditation. At last I address him thus: I am thinking, that when the sun set last night, he went down yonder; whereas, this morning, you see he is risen on the opposite side of the plain here before us. What can be the meaning of this?" I say nothing more at this time, but rather endeavor to direct his attention to other objects. This is our first lesson on cosmography. Our last observation was made about Midsummer; we will next view the rising sun, on some fine morning in the middle of winter. This second observation shall be made on the very same spot which we chose for the former. When Emilius and I perceive the sun now emerging above the horizon, we are struck at the change of the place of his rising. By such lessons as these may the pupil be taught a real, not a seeming acquaintance with the relative motions of the sun and the planets, and with geography." 

Natural history is another branch of knowledge by no means to be neglected in a liberal education. Of all the studies in which the youthful mind can be engaged, this is at once the most entertaining and the most instructive. Conversant about the objects in which we feel the earliest concern, it is peculiarly calculated to gratify the eager curiosity of children; while, by engaging this strongest principle in the juvenile breast, it trains them to the habit of observing accurately, of attaching distinct conceptions to words, and of classifying and arranging the subjects of knowledge: it gives a new interest to every thing around them, and, by extending their acquaintance with the Works of nature, it enlarges their ideas of their Great Author, towards whom it of course inspires them with warmer devotion, and with deeper reverence. "I would recommend botany," says an eminent naturalist, "for its own sake. I have often alluded to its benefits as a mental exercise; nor can any exceed it in raising curiosity, gratifying a taste for beauty and ingenuity of contrivance, or sharpening the powers of discrimination. What then can be better adapted for young persons? In Sweden, natural history is the study of the schools, by which men rise to preferment; and there are no people with more acute, or better regulated minds, than the Swedes." The next study in which we would engage our pupil, is the study of the mathematics, which, from the days of Thales to our own, has ever been regarded as of the most essential importance in the culture of the mind. We are told by almost every writer on the mental powers, or the means of improving them, that if we would enjoy the use of those powers in all their perfection, we must devote ourselves to the study of mathematical science. This alone, we are assured, or, at least, this more than any other study, will correct the wild flights of imagination, and will give to judgment its due superiority; will teach us, by perpetual examples, to conceive with clearness, to connect our ideas in a train of dependance, to reason with strength and demonstration, and to distinguish between truth and falsehood. Something of these sciences, they add, should be studied by everyone; not so much, as Mr Locke expresses it, to make us mathematicians, as to make us rational creatures. Now, while we admit the utility of the study of the mathematics in improving the powers of reasoning, it is not to be disguised, that, in one respect, their operation on these powers is often unfavourable. On subjects susceptible of strict demonstration, those who have been disciplined to the clear and consecutive arrangement which characterizes mathematical science, will probably reason most successfully. But there are many subjects on which, though not susceptible of demonstration, we may attain a certainty nearly as absolute. In the investigation of such subjects, mathematical reasoning will not apply; and we have not unfrequently seen mathematicians, who, refusing to believe what they could not demonstrate, were incapable of estimating the evidence of testimony and of circumstances, and were left in all the darkness of uncertainty on points which, to less confined understandings, were clear as the light of day. A less questionable advantage of mathematical knowledge is, its subserviency to most of the other sciences. To natural philosophy, in all its branches, it is indispensably necessary. Mathematics may be called the language which that science speaks, without which scarce a principle it unfolds, or a fact it communicates, can be properly understood. When our pupil, therefore, has acquired a competent knowledge of mathematics, let his attention be directed to natural philosophy, which will open to him a wide field of entertainment and instruction, and tend wonderfully to expand the powers of his mind. What employment
can be more interesting, or more worthy of a rational being, than to investigate the laws by which the universe is regulated, to describe the phenomena which result from these laws, and to trace them back through the long chain of causes, which may have contributed to produce them? Such an exercise will necessarily form the mind to habits of accurate and persevering observation; of patient enquiry, of abstract speculation, and of correct reasoning. While it restrains the thoughts within the limits of reality, it at the same time affords abundant scope for the most sublime conceptions, and the most excursive flights of imagination. Carrying us beyond the boundaries of sense, it weakens each selfish feeling, by interesting us in every thing around us. It is the best preparation for the study of mind; for the rigour with which its researches are conducted, and its cautious mode of reasoning by induction from ascertained phenomena, check that extravagant rage for theory, which is the bane of all science. To religion it is a most powerful auxiliary; extending our knowledge of the works of creation, and leading us "through nature, up to nature's God."

From the study of the material universe, let our pupil be conducted to the higher and more important study of the human mind. In some of our systems of education, mental philosophy is very preposterously made one of the earliest objects of the student's attention. In our Scotch universities, it is not uncommon to see lads, who should not yet have escaped the discipline of a grammar school, occupying the benches of a metaphysical class, and listening to grave lectures on the powers and operations of the human mind:—powers, which their minds have scarcely begun to exercise; operations, of which they are almost unconscious. How can boys, whose faculties are only beginning to open, be supposed capable of that reflective attention to their own ideas and emotions, often too fleeting to be arrested, too complicated to be unravelled, too faint to be perceived, which is the basis of all mental philosophy? Or, what benefit can they be supposed to derive from disquisitions on abstract subjects, of which they cannot form an idea, and which can be presented to them in no palatable shape? The inevitable, and almost the only consequence, of engaging them at so early an age in the study of what they cannot understand, is to excite their disgust, and thus to leave them in hopeless ignorance of science, which, if once by previous discipline they were prepared for comprehending it, they would have found the most delightful study, as it is the most important, in which man can be engaged. To the successful pursuit of mental science, an accurate and discriminating judgment, a clear and penetrating understanding, and a habit of correct and cautious reasoning, are indispensably necessary: the study of the mathematics and of natural philosophy is peculiarly useful in cultivating these valuable qualities, and ought, therefore, always to precede the more abstract and difficult study of mind.

One peculiar advantage of this study is, that, while it gives exercise to the highest of our faculties, it suggests at the same time the best means for improving them. By rendering us acquainted with human nature in all its parts; with its various faculties, powers, and sources of enjoyment; and the effects which are produced on these principles, by particular circumstances and situations, it aids us essentially in the proper and liberal culture of the mind, enables us to judge of our own acquisitions, and to employ the most effectual means for supplying our defects, and removing our improper habits. A philosophical analysis of the principles of the mind, is the only foundation on which can be raised a proper system of education; and as scarcely any of the existing systems are founded on such an analysis, almost every person of reflection, when he arrives at maturity, finds it necessary to begin a new course of education for himself. Now, to render that course as complete as possible, to enable him to estimate properly his attainments, and to know how to supply his defects, it is necessary that he should have an accurate and comprehensive view of his intellectual and moral powers; and such a view it is the professed object of mental philosophy to give. All the different branches of our knowledge bear a common relation to the philosophy of the human mind; and to that philosophy, of course, must be referred all our inquiries concerning the divisions and the classifications of the objects of human knowledge, and all the various rules for the investigation and the communication of truth. "As a philosophical system of logic," says Mr. Stewart, "would assist us in our particular scientific investigations, by keeping steadily in our view the attainable objects of human curiosity; so, by exhibiting to us the relation in which they all stand to each other, and the relation which they all bear to what ought to be their common aim, the advancement of human happiness, it would have a tendency to confine industry and genius to inquiries, which are of real practical utility; and would communicate a dignity to the most subordinate pursuits, which are in any respect subservient to so important a purpose. When our views are limited to one particular science, to which we have been led to devote ourselves by taste or by accident, the course of our studies resembles the progress of a traveller through an unexplored country, whose wanderings from place to place are determined merely by the impulse of occasional curiosity, and whose opportunities of information must necessarily be limited to the objects which accidentally present themselves to his notice. It is the philosophy of the mind alone, which, by furnishing us with a general map of the field of human knowledge, can enable us to proceed with steadiness, and in a useful direction; and while it gratifies our curiosity, and animates our exertions, by exhibiting to us all the various bearings of our journey, can conduct us to those eminent facts from whence the eye may wander over the vast and unexplored regions of science to which it has ascended.

While the study of mind is thus useful in teaching us how to exercise our own intellectual faculties, it is found of peculiar advantage in those arts which operate on the minds of others. The success of the poet, the painter, and the orator, depends on the skill with which they adapt the efforts of their genius to the powers and sensibilities of mankind; and a philosophical analysis of the mind is the only solid foundation for the improvement of all the fine arts. The human mind, too, is the subject on which the moralist and the statesman have to operate; and while the former endeavours to allure men to their truest happiness, by the cultivation of their noblest powers and their finest qualities, and the latter proposes to second the benevolent intentions of Providence, by diffusing as widely and as equally as possible the advantages of the social union; to each of them an extensive and accurate knowledge of human nature is equally necessary. To the moral improvement and happiness of the individual, the study of mental philosophy is still more eminently conducive. Enabling us to trace back through all their intricacy, our propensities and habits to their origin, it suggests
the best means of confirming those which are laudable, and correcting those which are faulty. Teaching us duly to appreciate the real excellencies of the mind, it guides us in our efforts for their attainment. And showing us how our happiness is affected by different modes of conduct, and by what means our excellence is promoted or obstructed, it enables us to form the most judicious plans for the regulation of our future life.

After being initiated in the philosophy of the human mind, our pupil will enter with peculiar advantages on the study of history, which will introduce to his observation, the passions, propensities, and faculties of mankind, acting on the ample theatre of the world. To a person who has made himself acquainted with the general properties of human nature, the study of history is peculiarly edifying. While it exhibits man in all possible circumstances, it enables him to refer to their true cause all the diversities of human character; and, amidst the almost boundless variety which obtains in the sentiments and modes of action that prevail in different communities, he learns to discriminate those which originate in the native and universal feelings of mankind, from those which are the result of local or national contingencies. He reaps the advantage of the accumulated experience of all nations and ages; and in the progress of states and their decline, can trace, with unerring precision, the causes of their prosperity and of their ruin. He sees the operations of Providence displayed here on the most magnificent scale; and while he compares the end with the beginning of the important transactions which history records, he obtains the most exalted and comprehensive view of those grand principles, which regulate the moral government of the Great Ruler among the nations. His ideas of society are enlarged, and he escapes from those illiberal prejudices, which the love of country, amiable as it is in itself, is too apt to excite against those who live under different governments, and in other climes. "There is scarce any folly or vice," says Lord Bolingbroke, "more epidemiical among the sons of men, than that ridiculous and hateful vanity, by which the people of each country are apt to prefer themselves to those of any other, and to make their own customs, and manners, and opinions, the standard of right and wrong, of true and false." This vanity is effectually removed by the enlightened study of history. He who is accustomed to contemplate the transactions of other nations, to view them in their mutual dependencies and connections, and to take a warm concern in all their interests, learns to consider the community to which he belongs as only a part of a still greater community; and without necessarily becoming indifferent to its prosperity and its fame, is enabled to discern the value of opinions and practices of foreign growth. To every student, however, the history of his own country is by far the most interesting. To trace the origin of those laws and institutions, to which, in common with his fellow citizens, he is subject, and of those customs and establishments by which the character of the nation is at once indicated and determined, is an employment no less pleasing to curiosity, than it is improving in its tendency. To the native of Britain, the study of the history of his own country is, in this respect, particularly important and gratifying. In no country have all the great virtues been more eminently displayed; no where has the struggle for civil privileges been carried on with more perseverance and success; liberty has here advanced through many vicissitudes and successive revolutions, to the most perfect triumph she ever obtained; protected by every security which wisdom can devise; and accompanied with all the blessings which usually follow in her train,—arts, science, commerce, pure religion, and enlightened toleration.

With the reading of history should be combined the study of political economy, and of the peculiar laws of our country, in so far as to enable us to understand exactly the extent of our respective rights and privileges, and the tenure by which they are held.

While the student is engaged in the acquisition of these accomplishments, let him be carefully trained to the practice of composition. The beneficial effects of this practice are too many to be here enumerated, and more extensive than we can easily calculate. The perfect command which it will give him of his own language, and the facility of communicating to others his sentiments and ideas, are perhaps among the least of its advantages. In whatever study he may be engaged, his progress will be more accelerated by the practice of composition, than by any other means. This will accustom him to think on every subject for himself; to ascertain exactly the extent of his attainments; and thus to advance with a steady progress towards proficiency. To write one page from his own reflections, will give him a more perfect knowledge of his subject than to read a volume. The habit of correct composition almost necessarily produces precision in our ideas, and perspicuity in our reasonings; and by obliging us to think closely, prevents us from resting satisfied with vague and superficial notions. The improvement of our taste is another effect of the practice of composition, scarcely less valuable than those which we have enumerated. He who has, learned to relish the beauties of nature and of art, has access to the most inexhaustible sources of enjoyment. It is of the last importance, therefore, to the future happiness of our pupils, to imbue their minds with an early relish for the pleasures of taste. Nor is it more essential to their happiness, than it is conducive to their excellence. A taste for what is great and beautiful is favourable to the growth of many virtues, and sanguine hopes may be entertained, that they whose minds have this elegant and liberal turn, will become conspicuous for the discharge of all the higher and more important duties of human life. There are, indeed, few good dispositions of any kind with which the improvement of taste is not in some degree connected. It increases by frequent exercise, the sensibility of all our tender and benevolent feelings; while, on the other hand, by impressing us with a deep sense of propriety, it tends to weaken all the fierce and violent emotions. To be devoid of taste, is justly regarded as an unpromising symptom in youth, indicating their propensity to low gratifications, and their incapacity for any thing but what is vulgar and illiberal.

Such are the attainments which constitute a liberal education; and such is the order, according to which, in our opinion, they ought to be acquired. But small is the proportion of mankind, whose circumstances enable them to cultivate their faculties by so extensive an education. A numerous class of men, destined for particular professions and employments, receive only such an education as seems necessary to qualify them for the situations which they are to occupy in society; and a still more numerous class, doomed to toil, almost from infancy, for a scanty subsistence, receive little or no education at all. Fortunately, men may become good and respectable members of society, without any very
extensive acquaintance with science and literature; but in whatever station or circumstances an individual may be placed, it is indispensably necessary to his respectability and his happiness, that he receive such an education as may enable him to exert the powers of his mind, and prepare him for all the duties of life. Among all classes of society, a proper education is the only permanent source of good conduct; and it is now pretty generally understood, that national prosperity and happiness depend, more than on any other cause, on the diffusion of instruction among all orders of the people. Ignorance is the parent of depravity; and most of the vices which degrade the character, particularly of the lowest class of the community, may be traced to the want of knowledge.

We are proud in having to appeal to our own country for a proof of the influence of general instruction in raising the national character. Since the establishment of parochial schools in Scotland, the people have been distinguished for their honesty, sobriety, and decency; and there is perhaps no country in Europe, as Dr Currie very justly observes, in which, in proportion to its population, so small a number of crimes fall under the chastisement of the criminal law as in Scotland. Every benevolent heart must rejoice in the prospect which the Lancastrian system affords, of the extension of the same advantages to our sister kingdom, and throughout the wide range of his Majesty's dominions. We do not mean at present to enter into an investigation of all the merits of that system, or its defects. One distinguished merit it does unquestionably possess, sufficient to recommend it to the warmest patronage of every lover of his country and of mankind,—the merit of placing within the reach of the lowest of the people the blessings of instruction, by enabling them to acquire a knowledge of reading, writing, and accounts, at an expense which the poorest can afford, and in a time so short as scarcely to deprive the most necessitous of any advantage which they might derive from the industry of their children.

EDWARDS, George, a celebrated naturalist, was born at Stratford, a village in Essex, in the year 1693; and, after receiving an ordinary school education, was put apprentice to a tradesman in Fenchurch-street, London; but before the term of his engagement was half expired, his attention was diverted, by an accidental occurrence, into a course of study altogether foreign from commercial pursuits. The library of a deceased physician, a relation of his master, having been removed into the apartment of the young apprentice, he embraced, with avidity, this unexpected opportunity of acquiring knowledge; and spent all his leisure through the day, and frequently a considerable part of the night, in perusing treatises on natural history, astronomy, antiquities, &c. Losing all relish for business, he adopted the resolution, at the expiration of his servitude, to improve his mind and enlarge his knowledge by travelling in foreign countries. In 1716, he visited the principal towns of the United Provinces; and, about two years afterwards, spent a considerable time in examining the natural productions of Norway. In the year 1719, he went to Paris, with a view to enlarge his acquaintance with natural history; but, finding the menagerie almost totally neglected, he applied his attention to the works of sculpture and painting; and made several journeys on foot to different parts of France, with no other object of being acquainted with the scenes on the Mississippi. Upon his return to England, he employed himself in drawing and colouring animals, particularly birds; and, by his assiduity and skill in this pursuit, he at once acquired a decent subsistence, and a number of valuable friends. By the recommendation of Sir Hans Sloane, he was in 1733 appointed Librarian to the College of Physicians, an office which afforded him the best opportunities of pursuing his favourite
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1743, 1747, 1750, and 1751, he published his "History of Birds," in four volumes, with coloured plates and descriptions, in French and English. The last of these volumes he dedicated to the Supreme Being; an act in which his piety may be acknowledged, but of which the example is not to be imitated. Resuming his labours, he published in 1758, 1760, and 1763, three additional volumes, under the title of "Gleanings of Natural History," consisting of coloured plates of birds, fishes, insects, and plants; and thus completed a work containing engravings and descriptions of more than 600 subjects in natural history. As an artist, he was remarkable for his scrupulous exactness in copying nature. He communicated occasional papers to the Royal Society, of which he was chosen a member; and, in 1770, he published, in one volume octavo, several essays, which had been prefixed to his larger volumes, containing instructions in drawing and painting in water colours, etching on copperplate, &c. He was admitted a member of several academies in different parts of Europe; and, besides the friendship and correspondence of the great Linnaeus, enjoyed the patronage of the principal promoters of the arts and sciences in his native country. In 1769, he retired from all public employments to a small house at Plaistow, and devoted the evening of his life to the conversation of a few select friends, and the perusal of a few favourite books. During his latter years, he was greatly affected by the stone, and by a cancer in one of his eyes; but remarkably patient. Emancipated with age and sickness, he died in 1773, and was interred in his native parish of West-Ham, where a stone is erected over his grave, with a plain inscription, to perpetuate his skill as a zoologist.

He was a man of middle stature, inclining to corpulence, of a benevolent disposition and cheerful temper; an entertaining and communicative companion to persons of congenial taste with himself; but, from his diffidence and humility, little calculated to shine in general conversation. See Biog. Brit.; Memoirs of the Life of Geo. Edwards; Anecdotes of Bunyan; and New Biog. Dict. (q)

EDWARDS, Thomas, a critic and a poet, was born in London or its vicinity, in the year 1699, and received his grammatical education at Eton school. He entered upon the study of the law at Lincoln's Inn, with the view of practising at the bar; but was discouraged by a remarkable hesitation in his speech, from engaging much in the duties of that profession. He applied himself indeed from his youth rather to the cultivation of polite literature, than to the perusal of the statutes; and was, in particular, an ardent admirer of the works of Shakespeare. He first appeared as an author in 1744, by publishing a letter to the author of a late epistolary dedication, addressed to Mr Warburton, in which he attacked the critical tenets of that celebrated writer. Warburton had hinted in the preface to his edition of Shakespeare, that he had once intended to have given his readers a body of canons for literary criticism; but now referred them to what he had occasionally said upon the subject in the course of his annotations. This idea was humorously taken up by Mr Edwards, who framed a set of canons ridiculously absurd, which he illustrated by examples from Warburton's notes. This performance appeared in 1747, as "A Supplement to Mr Warburton's edition of Shakespeare," and afterwards under the title of "Canons of Criticism." It was remarkably well received by the public; and besides effectually exposing the singular aberrations of the ingenious critic in question, holds up to deserved contempt, the rash and fanciful style of critical exposition and emendation which then began to prevail. Warburton, in return, introduced Edwards into the Dunciad, in a scurrilous note upon line 567, &c. of book fourth; a retort which the latter, from the irascible character of his antagonist, might have been prepared to expect, and which scarcely deserved the indignant reply which he prefixed to a future impression of his "Canons." He produced another small piece, entitled, "An Account of the trial of the letter y alias Y," which regards the orthography of the English language; and in which he chiefly recommends attention to uniformity in spelling, and to the marks of etymology. He was more eminent as a classical scholar, and an elegant critic in the English language, than as a writer of poetry. All his pieces in this last mentioned capacity, excepting one ode, were in the form of sonnets, in the style of Spenser, thirteen of which are printed in Dodson's collection, eight in Pearch's, four in Nicoll's; and the whole of these, with twenty-seven additional, are to be found in the last edition of his "Canons," in 1765. A small tract on predestination, was published after his death. From the year 1789, till his decease, he resided at his estate at Tur- rick. He died in January 1757; and, in an inscription upon his monument in the church-yard of Ellesborough, is described as a sincere Christian, a friend to the cause of liberty, and an enemy to licentiousness and faction. See New Biog. Dict. and Biog. Brit. (q)

EDWARDS, Jonathan, an eminent American divine, was born at Windsor in Connecticut in October 1703; and entered Yale College in 1716, where he received the degree of bachelor of arts, before he was fully seventeen years of age. He gave very early indications of his genius for abstract enquiries; and in his thirteenth year, used to take the utmost delight in studying Locke's Essay on the Human Understanding. He made a rapid progress in scientific pursuits, especially in the study of natural philosophy; but was particularly attached to moral philosophy and theology, as connected with his future occupation. Having continued at college two years after he took his first degree, he was licensed as a preacher of the gospel; and, in the year 1722, he preached during eight months with much acceptance, to the English Presbyterians in New York; but, as he did not consider the circumstances of that society such as to justify him in settling as their minister, he returned to his father's house in the following spring, where he spent the summer in close application to study. In September 1723, he was admitted master of arts; and, in the following year, was chosen tutor of the college in which he had been educated, where he continued in that office above two years. In 1726, he resigned his tutorship, and was ordained pastor of a congregation at Northampton, and colleague to his grandfather, the Rev. Solomon Stoddard. In this situation he continued to labour with the greatest success and approbation till the year 1744, when his endeavours to check the dissemination of licentious publications among the young persons of his congregation, and to exercise greater strictness in admitting communicants to the Lord's supper, excited such violent disputes and dislikes, as, in a great measure, terminated his comfort and usefulness at Northampton. In the midst of the most violent and uncandid opposition, he
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remained nearly six years longer, but was at length formally dismissed by a vote of his congregation, in which only 20 persons appeared in his favour, and more than 200 against him. During the whole of this afflictive struggle, he preserved the greatest calmness and meekness under the most injurious treatment, and, within a few years after his removal, was amply vindicated by the public acknowledgment of one of the most virulent of his accusers. He was, in short, the last minister in New England, of whom such an event could have been anticipated; and the whole transaction presents one of the strongest objections, from actual experience, to those forms of church government which empower the people to dictate to their religious instructors. In 1751, Mr Edwards was appointed Indian missionary, at the town of Stockbridge, in Massachusetts, where he was honourably supported by the Society in London for Propagating the Gospel in Foreign Parts; and where, for the space of six years, he discharged the duties of his office to the entire satisfaction of all concerned. During his residence in this retired situation, he produced the most valuable of his writings. In the year 1757, without any solicitation, and even with much reluctance on his part, he was elected to the presidency of the college of New Jersey, and removed to Princetown in the beginning of the following year. Searcely had he entered upon the duties of his office, and given testimony of his eminent qualifications, when he proposed, with the advice of the physicians, and the consent of the corporation, to be inoculated with the small-pox, which was then spreading its ravages in his neighbourhood. He had the disease in a favourable manner, and all danger was considered as past, but a secondary fever put an end to his valuable life, on the 9th of March 1758, in the 55th year of his age. He uttered very few words during his sickness, but evinced, in every stage of his disease, the most patient submission to the Divine will; and died at last with the utmost composure, as one falling asleep. Mr Edwards had a very infirm constitution of body; and, on that account, as well as from religious principle, was remarkably abstemious in his diet. He was nevertheless capable of great mental application, constantly rising about four or five o'clock in the morning, and commonly spending thirteen hours every day in his study. His usual recreation in summer was riding on his buck, or walking; and in winter he was accustomed, by way of exercise, to spend half an hour or more every day, in chopping wood with an axe. He possessed an uncommon thirst for knowledge, and read all the books, especially in divinity, that were within his reach. His own principles were strictly Calvinistic; but he drew them for himself from a thorough investigation of the sacred scriptures, and was least of all men led by the mere authority of others. He always studied with his pen in his hand, and, in this way, committed to paper many observations on almost every subject in divinity. The number of these miscellaneous reflections amounted to more than 1400, and a selection of them was published, in one volume, after his death. He was particularly careful in the composition of his sermons, which, for the first twenty years of his ministry, he generally wrote out at full length, and carrying them with him to the pulpit, usually read the greater part of what he had written. This, however, he considered as one of his deficiencies as a preacher. His mode of delivery was easy and natural, deficient in gesture, but full of solemnity. His voice was not strong, but distinct; and his words, without much noise or external emotion, were so full of meaning and expressive of inward fervour, that few speakers were more successful in commanding the attention of an audience. He was seldom tedious either in prayer or preaching, and generally employed the greater part of his discourses in the application or improvement of the subject. Unless when he was called by the sick, or heard that any of his people were under some particular affliction, he did not visit them in their own houses; because he was aware that his talent consisted in preaching and writing, rather than in teaching by conversation; but he encouraged all who desired his advice, to repair to his study, and regularly catechized the young persons and children, both in public and in his own house. He kept himself remarkably free from worldly cares, and committed the direction of his domestic concerns so entirely to Mrs Edwards, that he seldom knew even whence his table was supplied, or how many cattle he possessed. He was, however, most anxiously attentive to the education of his children; and his parental authority, exercised with uniform calmness, was productive of the most cheerful obedience. He spoke little in general society; avoided disputes in mixed companies; and was rather reserved among strangers; but, with his intimate friends, whom he selected with the greatest caution, he was peculiarly affable, communicative, and instructive in conversation,—patient of contradiction, and ready to hear every objection that could be made to his sentiments. He was distinguished by inviolable integrity in his dealings, and a sacred regard to truth in his words; uniformly impressed by a profound sentiment of piety, and characterized by an unaffected gravity of demeanour; exemplifying in practising, as he was most urgent in recommending, charity to the poor; but always inclined to conceal the amount of his alms deeds, and the exercises of his private devotions. His principal writings, besides single sermons and smaller tracts, were, "A Treatise on Religious Affections," published in the year 1746; "An Account of the Life of the Rev. David Brainerd, Missionary to the Indians, in 1749;" "An Inquiry into the modern Notion of that Freedom of the Will which is supposed to be essential to Moral Agency," in 1758; "A Defence of the Christian Doctrine of Original Sin," which was in the press at the time of his death; "A History of the Work of Redemption;" "Miscellaneous Observations;" and "Eighteen select Sermons," with an account of his life and character, which were published from his manuscripts. His writings, though expressed often in a clumsy and disjointed style, and capable of being greatly improved by judicious abridgment, have been highly valued, and extensively useful in the Christian world. He was certainly one of the greatest divines, and ablest metaphysicians, of the age in which he lived; and, whatever may be the theological sentiments of his readers, they must, if at all capable of appreciating his talents, allow him the praise of having possessed extensive knowledge of his subject; of having exercised sound judgment in his argument; and of having produced the ablest defence of the doctrines which he espoused. See General Biography, and The Life and Character of Mr Jonathan Edwards, prefixed to eighteen of his select sermons. (g)

EGBERT. See ENGLAND.

EGG. See Chemistry and Ornithology.

EGG. See ANQUINUM OVUM.
EGYPT.

PART I. HISTORY.

Among all the ancient nations which have been distinguished in history, there is none more worthy of our notice than the kingdom of Egypt. If not the birth-place, it was the early protector of the sciences; and cherished every species of knowledge, which was known or cultivated in remote times. It was the principal source from which the Grecians derived their information; and after all its windings and enlargements, we may still trace the stream of our knowledge to the banks of the Nile. Every ancient nation lays claim to a higher origin than legitimate history can sanction; and Egypt extends its claims to a fabulous period.

Antiquity of Egypt.

To extend the existence of Egypt as a nation to more than a hundred thousand years, is evidently fictitious; and the period 478,000 at Babylon, or 1,907,000, with more extravagant calculations still, which are found in the Indian chronology, are sufficient to convince us, that the pretensions are excessive, and the calculations untrue. There is a degree of vanity which every nation feels over its origin and its honour; and to this may in some degree be ascribed the extravagant claims of ancient nations. But this tendency is not sufficient to account for the inconceivable pretensions of Egypt, Chaldea, and Hindostan; nor are we certain that we shall be able to point out precisely the source of such claims. As Egypt was anciently divided into different kingdoms, the reign of cotemporary princes might be stated in traditionary history, as the reign of successive kings; but even this is quite inadequate to account for the incredible length of years, to which their pretensions extend. We have heard of a poetical and solar method of calculation in the East, in which a thousand years of the former are only equal to one of the latter. The Caliyoug of the Indian astronomers is clearly an imaginary period, as well as many other times and calculations so often alluded to in the ancient annals of the East.

It is impossible to ascertain correctly the circumstances which gave rise to these modes of reckoning, or the occurrences which from time to time enlarged or changed them; but we may easily believe, that, having once departed from the plain path of rigid calculation, they would branch out into many bye-ways, according to the ignorance, the fashion, or the fancy of the times. It appears that the earliest mode of reckoning was by the appearance and departure of the sun, when the evening or the morning marked the conclusion of a day. The changes of the moon, too, were periods of calculation. The revolution of the moon, and that of other planets whose courses were of short duration, appear to have been denominated years; as were also the terms of three and of four months. We speak not of the distinctions between the lunar and the solar year; for that was a mode of reckoning comparatively of recent date, and not once to be named among the circumstances, which have contributed to occasion the extravagance and uncertainty of remote calculations. But whether we have ascertained the true sources of those incredible pretensions, or even approximated their genuine causes, yet there cannot remain a doubt that their history is fabulous, and cannot be explained by the present modes or measures of reckoning. The want, or very imperfect method, of recording ancient facts, leaves us without the means of entering completely into their history; and we must content ourselves with partial inductions, or even with probable conjectures.

Menes is the first king of Egypt who is presented to our notice; but the circumstances of his reign distinctly imply, that the age in which he lived was an advanced period of the Egyptian history. The arrangements which he made did not belong to rude times; the wealth and the luxury of his court, were far removed from the savage state, and the magnificence which he introduced into the services of religion, manifest an improvement in the arts, and a progress in the splendour of society. Sir Isaac Newton ascribes to him the building of Memphis, which was not founded, or at least not famous, in the time of Homer; for it was Thebes and not Memphis which he celebrated as the glory of Egypt. Norden supposes that the latter was adorned from the ruins of the former; but even if this be true, it would not imply that Memphis was un-built till Thebes was in ruins. It will only shew, that, as the ancient capital was deserted, the new city was adorned with some works of art, which had been admired in the city of Thebes.

The imperfect state of the Egyptian history, in the period under review, is further apparent, from the deficiency of its annals immediately after the time which we have supposed to have been filled up by the reign of Menes. A list has been presented of 330 kings, many of whom were probably cotemporaries, and not a few of them perhaps imaginary. For if the reign of Menes was in some degree described, and did exhibit features of eminence and improvement, it is not likely that a period in immediate succession would be so void of information, and bear so many marks of romance and fiction. From the 1400 years which is fancifully ascribed to this interval, there is scarcely a circumstance which could claim attention, by any promise of entertainment or knowledge. For the story of the Shepherd kings, which seems to be connected with this place, is too obscure and undefined to excite much interest, or merit much notice. It cannot, however, be altogether passed over, as it is evidently entwined with the history of Egypt.

Various conjectures have been formed concerning that race of obscure kings; and some have supposed that it is the history of the Israelites in Egypt, misrepresented by fable, magnified and deformed by the uncertain traditions of ancient times. But the history of that people in Egypt has no resemblance to a reign of kings. In the time of Joseph, they must have had influence at the court of Pharaoh; but their subsequent condition in Egypt was a state of degradation, and affords a tale of misery and oppression. The Shepherd kings must have been cruel and severe, for their memory was detested; and their reign must have been previous to the abode of the Israelites in the kingdom of Pharaoh; for when Jacob and his sons went down into that country, a shepherd was an "abomination to the Egyptians."
Osyman-
dias.

It would be fruitless to fatigue ourselves with con-
jectures about the name or race of that people who invaded
and over-ran Egypt, and whose governors are denomi-
nated Shepherd kings. They must have been an un-
polished race of men; a wandering and unsettled tribe of
warriors, whose habits of life had not risen above the pas-
torial state. Being intruders, they must have been unwel-
come in the land of Egypt. Different in their manners,
rude and unformed in their habits, their conduct and prac-
tice must have been abhorrent from the milder manners of
a more polished people. Severe in their habits, and cruel
toward a conquered nation, their yoke must have been gal-
ling to a subdued and an oppressed people. Their de-
li
erance from so afflicting a thraldom must have been de-
lightful, and the memory of their sufferings would be
depth and lasting. The vast number of years during
which they are said to have held Egypt in bondage, was
a period which could not be reviewed but with distressful
remembrances, and the names of their oppressors must
long have been detested.

Osymandias is the next Egyptian king whose history
has assumed any probable shape; and yet the narrative
of his reign is doubtful and imperfect. While he was
upon the throne, the city of Thebes was still in its glory,
and some of its most remarkable ornaments are attribu-
ted to this prince. His palace was an edifice of exquisite
workmanship; and in the manner of those times, it was
of vast extent. In front there was a court of an immense
size; adjoining this space there was a portico of 400 feet
long, the roof of which was supported by animal figures
of fifteen cubits high. This portico led into another court
similar to the first, but much superer. Here, among other
ornaments, were three statues of vast size, which is alone
sufficient to shew the antiquity of Osyman-dias' reign.

In the infancy of science, every thing is vast; and
to command admiration among the uncultivated, immensity
is better calculated than beauty, deep design, or elegance
of workmanship. These statues are said to have repre-
ented Osyman-dias and some of his family; but this is
of little importance to the history of those times, which
leads us to approximate the period of society in which
Osyman-dias lived, by the state of literature and science
which belong to the period of his reign. Sculpture and
the art of building had evidently arrived at considerable
improvements. For the style of architecture, as well
as the art of the statuary, which the ruins of Thebes have
disclosed, have justly commanded the admiration of the
curious and discerning. There were other courts, and
other porticos, together with piazzas, halls, and galleries,
which excelled in workmanship as well as in extent.
There the chisel had sculptured, with wonderful art, the
triumphs of the king, the sacrifices which he offered, the
administration of justice in the courts of law, and many
other emblems of his transactions and reign. But his
tomb has been celebrated above all other buildings at
Thebes; and it has been chiefly remarkable for the em-
blems of astronomy which it bore. It was encompassed
with a golden circle of 365 cubits in circumference, to
represent the number of days which were then included
in the year, and shews that the solar year was not then
distinctly understood. Here the rising and the setting
of the stars were represented to view; various parts of
the ceiling in the public buildings of Osyman-dias were
painted blue and bespangled with stars, to exhibit an idea
of the firmament; and a hall was stored with the most
valuable writings of those times, and was significantly
denominated the dispensary of the mind. From the
whole it appears, that the reign of Osyman-dias, though
remote and not accurately defined, was in a period of
considerable improvement.

His lineal descendants are said to have reigned in Egypt
during the course of eight generations; but their trans-
actions, and even their names, are not distinctly known.
Uchoreus was the last of that race; and in his time the
city of Memphis appears to have become the successful
rival of the ancient and venerable city Thebes. It is in-
deed added, that he transferred the abode of the Egyp-
tian kings from Thebes to Memphis.

Passing by other sovereigns, who are rather alluded to Meri-
than specified in the conjectural parts of this history, we
shall take notice of Meris, who would probably have
been left in the same obscurity as many other ancient
kings of Egypt have been, had not the lake which bears
his name preserved his memory. That work of stupen-
dous labour will be adverted to in a subsequent part of
this article; and it may be considered as a remnant of
those mighty works which Meris did to aggrandiz his
kingdom. He adorned the temple of Vulcan at Mem-
phis, and must be supposed to have been the author of
many important improvements, which have been lost in
the lapse of time, and forgotten among the changes of
early and obscure events. He was the 330th king from
Menis; and the immediate predecessor of Sesostris,
whose history is now to claim our attention.

Sesostris is known by various other names, according
to the variety which different languages and other cir-
cumstances are calculated to produce, such as Sesonchis,
Sesoasis, and Sesothis. He has also been supposed to
be the Sesac or Shishak who took Jerusalem in the reign
of Rehoboam; while others have supposed that he was
the Pharaoh who reigned in Egypt, and who was drow-
red in the Red Sea, when pursuing the Israelites to bring
them back; but these are conjectures, and not historical
facts—they may amuse, but they cannot instruct. Under
the pretext of a dream, his father adopted measures
which, in his view, were calculated to furnish his son
with certain means of conquest and power. Exercising
the influence which he seems to have possessed, he col-
clected a number of youths of the same age with his son,
and trained them up together at his own expense, that
they might be attached to the person of Sesostris; and
that, by being trained up in a hardy and active manner,
they might be able to brave dangers, and be the means
of honour and aggrandisement to his son.

Having made successful inroads into Arabia, and be-
ing led to put confidence in his own resources and skill,
Sesostris returned into Egypt, and devised measures for
such campaigns and conquests as have perpetuated his
fame. Being resolved to take the field in person, and
having the prospect of being a long time absent from his
kingdom, he adopted prudential means for preserving
tranquility while he was abroad. By promises and sal-
atory arrangements, he attached the army to his inter-
rest; and he provided carefully for the internal peace
of the state. He divided the empire into 36 provinces,
and having appointed a governor to each, he constituted
his brother regent of the kingdom, with supreme power
till he himself should return. He fitted out two fleets,
one in the Mediterranean, and the other in the Red Sea.
With the former he conquered the islands of Cyprus, to-
gether with several islands of the Cyclades, and the whole
coast of Phoenicia; and with the latter he secured the
Red Sea, and entered the Indian ocean.

His army was in great force. It consisted of 600,000
EGYPT.

EGYPT.

Sesostris II, or Phœnus as he is sometimes called, scarcely deserves to have his name mentioned in history; for his life was inactive, and his reign inglorious. Like the former Sesostris, he was seized with blindness; but by patience and proper remedies his sight was restored. We give no heed to the fabulous manner in which his cure has been represented; blindness appears to have been of old, as it is now, a common disease in Egypt. Now a period fruitful of no authentic information occurs again in the history of Egypt; for here and there are only some casual and ill ascertained spots of verdure transiently appearing amidst a vast succession of ait wastes. About this time, though we cannot speak with precision, we may venture to suppose, that the Israelites departed from the land of Egypt. For in the reign of Actæanes, the Ethiopian adventurer, who drove the detested Amasis from the throne, there is an obscure, and seemingly disguised account, of a foreign people being driven from Egypt toward the land of Palestine.

After a long interval we meet with Cetes, who, in the Protes or language of Greece, was denominated Proteus. He was celebrated in ancient fable, and on account of his wisdom, and perhaps his dexterity in the art of deception and enchantments, was said to have the power of changing his form. Dwelling upon the sea-shore, or perhaps encouraging commercial affairs, he was said to be a sea god. Into one of his ports Paris was driven when he was carrying off Helen from her husband Menelaus. Finding that Paris had violated the rights of hospitality, and fled with the wife of his friend, he dismissed him from his presence; but retained the fair, though faithless lady, to be sent back to her injured lord. In the mean time a war was undertaken against Troy; for the Greeks would not be persuaded that Helen was not concealed in that devoted city.

The reality of this memorable siege has been called in question by Mr Bryant; and in many respects his opinions are singular; but similar sentiments seem to be entertained by some modern travellers; or at least, they have not been able to discover the scene of those splendid actions, which have adorned the classic page, and delighted the heart of the youthful student. We believe that the fall of Troy was a real and momentous transaction, though disfigured by tradition, and short comedies embellished by the poets. It is not wonderful, that the site of Troy should not be known. Ancient cities in the East consisted chiefly of mud or very perishable cottages, except the temples and a few public buildings, which were easily overthrown in a deserted city, and even their fragments sunk or carried away.

To Proteus succeeded Rhampaulius or Remphis, who would scarcely deserve our notice, if he had not been the son of the last king, and raised to the throne in due order of succession. He is represented as having been excessively attached to riches; and as having erected an expensive building for the reception of his treasure. In times like those in which he reigned, it is natural to believe that means would be employed to spoil him of his wealth; but the story of Herodotus concerning the device of the architect for giving himself a private mode of access to the king's treasure, and other circumstances attending the abstracting of his money, are unworthy of record. Snares might be laid to detect the offender who had plundered the King, but that one brother should cut off another's head when he was held fast, and could not escape from the trap, which was laid to discover the
offender, and that he should carry off the head to prevent a discovery, is rather fabulous than probable. Far less can we conceive, that a father, though wicked, would induce his daughter to enter into criminal intrigues to obtain from her admirers the secret of the theft. He is said to have enlarged and adorned the temple of Vulcan.

Here, again, there is a gap in the history of Egypt; and the first king, who claims our notice, is Cheops, who was also distinguished by a variety of other appellations, and is said to have erected the largest of the Egyptian pyramids. He began his reign with shutting up the temples of the gods; and forbidding every species of religious worship. He was as tyrannical as he was impious; and he oppressed the people for the space of fifty years.

His successor Cephen, or Chabryis, trode in the steps of the former king. He, too, built a pyramid with excessive labour and expense to the people, whom he had enslaved; and so much was he detested during the course of a long reign, that the place of his burial was kept secret, lest the populace had treated his remains with dishonour and indignation.

Myrcinus. Myrcinus, or Cherinus, the son of Cheops, detesting the injustice and impiety of his father, pursued a different and an amiable course. He honoured the gods, threw open the temples, and encouraged sacrifices to be offered. He delivered the people from every species of tyranny, and restored to them a life of tranquillity and freedom. He tempered the severities of the law, and was in truth a benevolent father to his people. But while he was diffusing happiness around him, and all classes of society were enjoying the fruits of his benevolence, a heavy and domestic calamity befell himself. The death of a favourite daughter threw a gloom over every object of nature, and appears to have affected the strength and steadiness of his mind. Her sepulchre seems to have been adorned with much splendour, and her memory to have been preserved, by the frequently occurring observance of solemn and impressive rites.

The honours, which were ordained in remembrance of his daughter, appear to have been connected with some sacrifices or offerings of respect to the god Apis; and upon these circumstances, a fabulous story seems to have been invented, about the manner of the princess's death, and the whole scene was represented before her tomb. The king himself appears to have been affected in the exercise of his intellectual powers; for he abandoned his former quiet and virtuous mode of life, and gave himself up to every species of riot and intemperance. It is said also, that he too built a pyramid, and inscribed his name upon its northern front.

The first king who is mentioned in the Egyptian history, after the preceding sovereign, is Gnephactus, who is of no celebrity in the annals of his country. His manners were simple, and his abstinen ce proverbial. The luxury of his time appears to have been excessive; and its tendency was the more alarming to his mind, when he brought it in contrast with his own moderation. The beginning of those luxuries, of which, we presume, he justly complained, was ascribed to the reign of Menes, who introduced many valuable improvements of civil life; and who, along with these, gave a currency perhaps to many indulgencies which had risen to excess. It is said, that with the approbation of the priests and courtiers, a curse was pronounced upon the memory of Menes, and the curse inscribed upon a pillar.

What effect the proceedings of Gnephactus had upon the dissolute manners and habits of the Egyptians, we are not informed; but his son and successor, Bocchoris, was a prudent prince, and appears to have adopted such measures, as were best calculated to correct the excesses of which his father complained. He introduced the best regulations into every branch of police; and administered the public revenues with judgment and moderation. He was accounted one of those princes, who properly deserved the name of legislators in Egypt; for he improved its domestic economy, and enlarged its foreign relations. Like the Chinese, the ancient Egyptians resisted an intercourse with other nations; but this hurtful prejudice had gradually given way under the administration of different kings; and Bocchoris gave his aid towards the removal of so pernicious a restraint. He encouraged commerce, and promoted the general happiness of his kingdom. But in the midst of these valuable improvements, he was attacked by Sabacco, a prince of Ethiopia, by whom he was overthrown in battle, and having been made a prisoner, was inhumanly put to death.

Though Sabacco ascended the throne of Egypt by a striking act of cruelty; yet when he had attained the sovereign power, he was remarkable for clemency and conciliating manners. But he never appears to have reigned in the affections, or with the consent of the nation. In particular, the priests were hostile to his government; and we are told in the legends of those times, that he was warned in a dream to destroy the priesthood, if he wished to remain king of Egypt. But we are rather to believe that he found the nation unfriendly to his authority; and as the priests were then the nobles and most powerful persons of the kingdom, and inimical to his reign, he had probably conceived a plan of putting those enemies to death, by a sudden and unexpected attack, and thereby overawing the people to submission; but either from principle or fear, abandoning so desperate an undertaking, he abdicated the throne, and retired into Ethiopia. He is supposed to have been the So of the scriptures, who entered into a league with Hosea the king of Samaria, to oppose and keep in restraint Shalmaneser the king of Assyria.

Sethon is the next king of Egypt, who lays claim to our consideration. He was a person of the sacerdotal order, and belonged to the temple of Vulcan. He had no warlike dispositions, nor was he at all habituated to the use of arms. Till now the soldiery had been cherished, and were a conspicuous body of men in Egypt; and therefore being neglected by Sethon, they were dispersed, and hostile to his interests. The kings of Assyria being at this time bold and successful warriors, and finding Egypt in a feeble and unprotected state, they entered that country in a hostile manner, and filled the nation with alarm. The soldiers being scattered and disgusted, Sethon's army consisted only of raw and undisciplined troops, who were unable to meet a host of victorious invaders. Semnacherib king of Assyria, with a numerous army, entered Egypt, and committed great devastations.

In this threatening and dangerous situation, when ruin was apparently ready to burst upon the head of the Egyptian king, a host of rats in one night gnawed the bow-strings and shield-strings of the Assyrian army; and being thus deprived of their weapons of warfare, they fled before the Egyptians with great slaughter. A story somewhat alike to this Egyptian representation, is handed,
ed down to us in the history of Palestine, where 185,000 men of Sennacherib's army were found dead by some sudden disaster. The better authenticated Jewish history would lead us to suppose, that the story is the same, but misapprehended and disguised in the obscurer annals of Egypt. The Babylonish Talmud supposes, that this sudden destruction was brought upon the Assyrians by the effect of lightning; while others are of opinion, that the disaster was occasioned by the sudden or hot wind of the desert, which is known to be so destructive and so sudden in its effects; and this idea seems to correspond with the language of our sacred books. " Behold I will send a blast upon" Sennacherib, and he "shall return to his own land."

But to whatever cause we ascribe the destruction of Sennacherib's army, it was equally the work of God; for all the parts and elements of nature minister to his will.

For some time past there had been a feebleness in the government of Egypt. At one time the country had been over-run and taken possession of by an Ethiopian adventurer, Tirhakah, a prince and warrior from Upper Egypt, fought against Sennacherib, and appears to have been a principal agent in driving him from the country; Setbon seized upon the kingdom when there was no powerful claimant to oppose his pretensions; and in short there seems, about this time, to have been a period of misrule, when no legitimate sovereign was invested with full authority.

Upon the death of Setbon, the kingdom of Egypt was divided into twelve governments; and each of them was entrusted to a separate head. Nothing can be a more decisive proof than this, that there was no lineal prince to demand the throne; or that for some malversations in government, the reigning family had been dismissed from the sovereign power. The twelve princes, to whom the government was now entrusted, appear to have entered upon their high office, with every resolution of concord and public spirit; but, like all common alliances, the harmonious union was soon dissolved.

Psammeticus, one of the twelve, was soon raised to the sovereign power, and his colleagues were overthrown. The story runs, of an oracle having asserted, that if any of the twelve governors should offer a sacred libation in a brazen helmet, that person should ascend to the sovereign power. The story adds, that upon a festival of Vulcan, when all the twelve governors were to offer libations to the god, eleven vessels through mistake were only provided, upon which Psammeticus presented his libation with his own helmet of brass. The prediction of the oracle was remembered; and Psammeticus claimed the sovereign power.

This elevation of Psammeticus to the throne of Egypt, we presume to be contingent rather in appearance than in reality; for it was more probably a scheme, that was concerted for restoring him to the kingdom of his fathers. He was the son of Nechus, whom Sabaco, an Egyptian invader, first dethroned, and then put to death; and his pretensions to the throne appear to have been neglected during the troublesome and unsettled period, which has just been described. The claim of the ancient royal family in the person of Psammeticus would naturally be supported by the priests, who were the nobles and hereditary counsellors of state. If the story of the helmet be not a fiction, it was probably contrived beforehand by the friends of Psammeticus, to be a signal for a powerful rising and declaration in his favour, as the destined sovereign of Egypt.

But he seems to have required the aid of foreign power to place or establish him upon his throne; and his reign was distinguished by an intercourse and friendship with Greece. The soldiers of Egypt, who are said to have retired in disgust into Ethiopia, were probably the adherents of the eleven governors whom Psammeticus had deprived of their power, and the remaining supporters of the surreptitious kings, who had reigned between them and his father Nechus. The restoration of the legitimate family appears to have been the means of removing the factions and discontented from the bounds of the kingdom. Psammeticus, in order to be more secure from the dangers of intestine commotions, returned to a residence near Bubastis, on the Pelusian branch of the Nile; and, by cultivating commerce, he enriched the nation. He was not a warlike prince, for the siege of Azotus employed all his force for the space of twenty-nine years; and it is not certain, that he ever obtained it. Fearing the warlike Scythians, he entered into an alliance with that nation, and was rather desirous of peace than war. He was the first prince who introduced wine into Egypt, and he attempted to discover the source of the Nile. If, as it has been reported, he brought up two children from their infancy, till they could distinctly articulate without having heard a human voice, in order that he might discover the language which is natural to man, if this be not a fiction, it was an evidence of a vain imagination rather than a sound judgment; for whatever was the first language of the human race, it could not be the effect of any natural organic tendency to speak one language rather than another. Psammeticus commenced his reign 679 years before the Christian era.

His son Nechus succeeded him on the throne, who was called in scripture Pharaoh Necho. He prosecuted with vigour the system of navigation, which some of his predecessors had begun; and, by the assistance of Phoenician sailors, he not only investigated the coasts of the Mediterranean; but fitting out a fleet in the Red Sea, passed through the Straits of Babelmandel, doubled the Cape of Good Hope, and returned to Egypt through the Straits of Gibraltar. Owing to inexperience in naval affairs, this voyage, which could now be performed in three months, cost the Egyptians as many years. Notwithstanding what has been said to the contrary, there is no reason to doubt the authority of Herodotus, who mentions this navigation; for in those early times the Phoenicians sailed to Britain for obtaining tin. Hanno established colonies on the western coast of Africa; Sylax came from the Indus to the Red Sea; Nechus passed from the Indus to the Euphrates; and the fleets of Solomon made long voyages, in search of gold and precious merchandise.

His expectations by land were no less enterprising and grand. He made war upon the Medes and Babylonians, who, according to Josephus, had jointly overthrown the Assyrian throne; but we are rather authorised to assert, that he carried his arms against the Assyrian king himself. Josiah, who was then king of Judah, and in friendship with Assyria, refused to let Nechus pass through his kingdom; wherefore a battle was fought, in the valley of Megiddo, between him and the king of Egypt, when Josiah was wounded, so that he died. Pharaoh Necho, marching on to the banks of the Euphrates, took the great city of Carchemish; and having occupied it with a garrison, and made various important arrangements, he returned toward Egypt. Jehoshaz had assumed the royal dignity at Jerusalem upon the death of
Josiah; the king of Egypt commanded him to appear before him at the Riblah, cast him into chains, and sent him into Egypt. His brother Eliakim had his name changed into Jehoiakim, and was left tributary king of Jerusalem. But the Assyrians having been added to the Babylonian empire, Nebuchadnezzar retook Carchemish, and, seizing upon Nebuchadnezzar's other conquests, pursued him and his army to the city of Pelusium.

Besides his enterprise by sea and land, Nechus attended to the improvement of his kingdom; and, among other undertakings, he attempted to join the Red Sea and the Nile, by means of a broad and deep canal. The enterprise failed; and owing, we may presume, to experience, much money was uselessly expended, and 12,000 men were lost. After having reigned for sixteen years, this active prince terminated his career about 600 years before the birth of Christ; and was succeeded by Psammis, who only reigned six years, and left nothing of consequence for the historian to record.

Psammis, B. C. 594.

Psammis, the son of the former king, now got possession of his father's throne; but though active, he was unwise and unfortunate. The king of Judah, bearing ill the tributary condition of his country, manifested signs of disobedience, and Judea was invaded by the armies of Babylon. To oppose those mighty forces, Zedekiah king of Judah entered into treaty with the king of Egypt; but Jerusalem was overthrown, and the king, as well as the other inhabitants, treated without mercy; while one of their former kings, and many of their countrymen, were prisoners at Babylon.

The Jews were warned to put no trust in a confederacy with Egypt; and any alliance with the kings thereof was evidently precarious; because the country had been long torn by intestine divisions, and during that period, every successive monarch had found more difficulty than enough to maintain his own power and prerogatives. The prince now upon the throne does not appear to have possessed the favour of his subjects; and therefore it was rather the unsettled condition, than the deceitful intentions of those Egyptian kings, which made them unworthy of alliance or trust. This observation is clearly illustrated by the fate of Apries.

When the Lyrians were invaded by the people of Cyrene, the king of Egypt sent his assistance in support of the former; but he and his allies being overcome, his discontented subjects at home broke out into rebellion. To quell those disturbances, and reduce the people to obedience, he sent Amasis on an embassy into Egypt; but the ambassador proved faithless, and being proclaimed king by the tumultuous multitude, he assumed the royal authority. Patarbemis being sent to bring the people of Egypt back to their duty, found it impossible to accomplish his mission; but upon his return to Apries, he was dealt with as a traitor; and these severities increased the hatred of the Egyptians. Apries collected a considerable body of adherents, mingled with foreign troops, and fought a battle with the army of Amasis; but being overthrown, he was kept a while in confinement, and finally put to death. During these intestine commotions, the king of Babylon made inroads into Egypt; but plunder being his chief object, he retired from the country without further molestation.

Amasis, who had been called unexpectedly, and without any pretensions, to the throne, began his reign by attempting to improve the moral condition of the country. He appears to have lived freely, as well as sometimes riotously, while he filled an inferior station; and he was sometimes devoted to excess, even after he had ascended the throne; but he was nevertheless aware how important it is for good order, that the habits of society should be sober. To attain this end, he required every inhabitant of Egypt once a year to inform the government, by what means he obtained his living. But while he was endeavouring to establish order at home, preparations were made abroad to invade Egypt, and overthrow its government. The Persian king was making vast movements, in order to enter that country and get possession of its dominions.

We cannot ascertain the reasons of this projected invasion in the court of Persia; for while no well authenticated records remain, we cannot speak with certainty from traditional tales. It might be ambition, and it might be revenge, or a mixture of passions and motives, which incidents and unknown events might bring into action. The story runs, that instead of permitting his daughter to be numbered amongst the women of the king of Persia, he had sent Nitetis, the daughter of Apries, the former king. This affront and double dealing being discovered at the Persian court, Cambyses made war upon Egypt. Several circumstances occurred to render the invasion of Cambyses successful; and of these occurrences Amasis himself appears to have had a share. Phanes, a Grecian general of considerable note, who was engaged in the service of the Egyptian king, fled to the court of Persia, and assisted Cambyses to conduct his operations against the interest and power of his former master. Polycrates, the successful sovereign of Samos, was formerly the ally of Amasis; but the king of Egypt seems imprudently to have forfeited his favour, and he also joined with the Persian king. While these preparations and adverse circumstances were going on, the king of Egypt died, and escaped from the disasters which fell immediately upon his devoted country. In the year 523 before the birth of Christ, Psammithus, the son of Amasis, succeeded to the kingdom; and he was severely invested with the powers of royalty, when Cambyses approached the frontiers of Egypt. The new king prepared for defence, and the king of Persia laid siege to Pelusium. Taking advantage of the Egyptian superstition, the invaders placed in the front of their army a variety of dogs, cats, and other animals, which were held sacred by the besieged; and the Egyptians not daring to injure the sacred animals, the Persians entered Pelusium without resistance.

Scarcely had Cambyses taken possession of the city, when the army of Psammithus drew nigh; and the Greeks, who were in the service of the Egyptian king, to revenge the deflection of Phanes, their countryman and former general, brought forth his children into the camp, and put them to death before the eyes of their father. Then, in conformity to the Grecian manner, they tasted of the blood mixed with wine, in token of exclamation.

It was thus also that Catiline prepared his adherents for the bloody deeds, which he intended them to do. Enraged at this scene of horror, the Persians put the Egyptian soldiers to flight, and chased them with great slaughter to the very gates of Memphis. Having sent a vessel up the Nile toward Memphis, with a demand to surrender the city, the messenger and the crew were assaulted and torn to pieces. Memphis was soon after taken; the adjoining countries to the west of Egypt readily submitted to the conqueror; and now Cambyses,
in his turn, did more than fill up the measure of retaliation upon the king of Egypt and his devoted subjects. Placed in a particular situation in the suburbs of Memphis, Psammeutus was forced to behold the misery, the degradation, and even the death of some of his family, and many of his nobles. The grief was too great to permit the feelings of the king to be otherwise expressed than by expressive silence, till last of all, an intimate companion, old and infirm, was presented before him, begging his bread; and then the afflicted monarch burst into tears.

We are told that Cambyses himself was moved with compassion; but making every allowance for the rudeness and severity of the times, the conduct of Cambyses was marked with cruelty. He inhumanly scourged the priests of Apis, and increased the madness and hatred of the people, by saying that god himself. Indeed the whole government of Persia in Egypt was unfortunate and severe. The conquerors were not only disliked as foreigners; but they were hated as sacrilegious persons, and detested as cruel and unjust. Though Psammeutus was preserved at this time; yet he survived but a little while the loss of his kingdom; for either he attempted to recover the throne, and excited an alarm, or Cambyses was determined to free himself of a rival; and in a very short time he was put to death.

The ancient race of kings had now ceased in Egypt. For several successive generations, the claims to the throne had been wavering, the country unsettled, and the kingdom feeble; but Egypt was now a province of Persia, and was destined to bear a foreign yoke. This species of government, at all times unpleasant, was rendered grievous, by the cruelty and madness of Cambyses. He trampled upon the laws of their country, and violated all their prejudices and prepossessions. He insulted the dead bodies of their ancestors, which are dear to every nation, but peculiarly sacred to the Egyptians. In order to affright that people the more, he violated the remains of their patriotic king Amasis; and by every enormity insulted their feelings.

In his madness for conquest, he dispatched an army of 50,000 men from Thebes in Upper Egypt, to seize upon the temple of Jupiter Ammon in the deserts of Africa; but after suffering every hardship, and losing nearly the one half of his army, he wreaked the vengeance which should have been directed towards his own folly, upon the afflicted and despairing Egyptians. He reached Memphis at the time of a high festival, and, with that jealous violence which belongs to tyranny, he was transported with rage, and would not be convinced, that the public rejoicings were not occasioned by his disappointment and defeat. Under this persuasion, he scourged the priests, put the magistrates to death, and, with his own hand, slew the god Apis, whose festival the Egyptians were observing. But a period was soon put to his cruelty and his life; for having returned to Persia to quell an insurrection in his own kingdom, he appears to have been assassinated; or, as the incident is generally related, he was mortally wounded by his own sword, from which the scabbard had dropped, as he was eagerly mounting his horse. Thus died Cambyses, an object of hatred to his subjects, and a detested tyrant to the Egyptians.

Aryandes, to whom the government of Egypt was committed when Cambyses returned into Persia, endeavored to compose the agitated feelings of the Egyptians, and render himself in some degree acceptable; and his exertions were not unsuccessful. He was mild and gentle as a patriot governor; by consulting the sages and priests, he complied with the institutions of the country, and honoured the religious worship of their fathers. Favored with the support of the Egyptian people, he assumed the ensigns of royalty; and appears to have become formidable to the Persian power. When Darius was meditating revenge upon Greece, for the defeat which he had sustained at the battle of Marathon, he found it necessary to direct his army towards Egypt, to overthrow the influence and kingly authority which Aryandes had acquired. In the mean while, Darius died; and his son Xerxes undertook the enterprise, which his father had intended to perform; and having overthrown Aryandes, his brother Achimenes was constituted governor of Egypt.

No sooner was this arrangement made, than 300,000 men were dispatched to Greece to place that country under the power of Persia; and the whole of this mighty army was to derive its provisions from Egypt. Achimenes furnished 200 vessels of war properly manned; and a considerable body of Egyptian troops joined the Persian army. But the brave Greeks, though comparatively few in number, opposed and overthrew the mighty invaders. Upon this defeat, Xerxes returned to Persia, and having given himself up wholly to dissipation, the affairs of his government ran into confusion, and he fell a sacrifice to a powerful conspiracy. Artaxerxes, one of his sons, ascended the throne; but under his reign the Egyptians were equally oppressed, and many of them fled into different countries for safety and protection. Inarius was at that time king of Lybia; and a multitude of Egyptians invited him to their aid. They also solicited and obtained help from the Athenians; but after various results and partial successes, they were compelled to yield to superior power, and sunk again under the Persian government.

For some time after this, the affairs of Egypt remain unnoticed; but at length we find that Amyrteus, who had found protection among the sons of the Delta, had become formidable to the Persian king. During this period, Artaxerxes died, after a reign of forty-eight years, and his son Xerxes succeeded to the throne; but his reign continued only a few weeks, when he was assassinated by his brother Sogdianus; and the assassin himself was soon put to death by his brother Ochus, who assumed the name of Darius, and is distinguished in history by the appellation of Nothus, which is descriptive of his illegitimate birth. During these commotions in Persia, Amyrteus, in connection with the Athenians, marched against Persia; but at last died, or was slain in battle, when he had reigned about six years. The reign of his successor, Pausiris, was short but tranquil; and the patriots of Egypt acquired considerable strength. Artaxerxes, who was now king of Persia, saw the increasing power of Egypt, and was determined to suppress it. Achorius, who had acquired the government of Egypt, made formidable preparations to oppose the invasion, but he died in the midst of his exertions, and was succeeded by Psammuthis, whose reign was unimportant. The same may be said of Nephrenitis, who held the government but a few months; and then Nectanebus obtained the sovereign power.

Nectanebus made active preparations to repel the Persians;
When unfazed for national but literary, skilful, but Persian, but a warrior, render.

This Bugos, chos in influence being difficulty with purpose. Pherendates, a Persian, was now intrusted with the government of Egypt; and his conduct was marked by rapacity and oppression. Hitherto the severities of Persia had been warded off or mollified, by the intervening influence of a national governor; but now the people were exposed to the prejudices and cruelty of an unrelenting foreigner, though in the mean time the government of Persia was on the eve of destruction. The unfeeling conduct of Ochus towards Egypt was avenged by Bagoas, an Egyptian, who held a place of trust under the Persian king. Upon the death of Ochus, Codomanes was raised to the throne, with the surname of Darius. This feeble king was unable to maintain his power, and both he and Bagoas were soon humbled in the dust.

It was in this enfeebled condition of Persia, that it was attacked and overthrown by Alexander the Great. Persia, from being an obscure but warlike state, rose to great eminence in the scale of nations. In the days of its vigour and glory, it had frequently been the terror of Greece; and when its power declined, the Grecian states in their turn were desirous of invading Persia. Philip of Macedon had not only strengthened his country by the military knowledge and science of Greece, but he became generalissimo of the Grecian armies, and was ready to invade Persia, when he fell by the pious hand of an assassin. His eldest son Alexander was but twenty years of age; yet having distinguished himself by extraordinary talents as a warrior, and having been trained up under the care of the celebrated Aristotle, he succeeded his father in commanding the confederated army of Greece. He marched into the Persian dominions, and was no less successful in gaining the affections of every country which he entered, than he was in conquering the armies whom he engaged in battle.

In returning from Persia, he passed as a conqueror through Syria, took Sydon, and compelled Tyre to surrender. Continuing his march, he was received in Egypt rather as a friend than a conqueror; but his vanity led him to the temple of Jupiter Ammon, where he was declared to be the son of that deity. When he returned into Egypt, he founded the city of Alexandria, as a good commercial station, and connected it by canals with the river Nile. On the eve of his departure, he invested Dolopes, a native Egyptian, with the sovereign power, and he carried along with him the affections and the regret of the Egyptian people.

Returning into Persia, he became master of Babylon, Susa, and Persepolis, while Darius was treacherously murdered; and after a few struggles, the great and celebrated empire of Persia was dissolved. But the termination of his own life drew nigh; for returning to Babylon, he expired in that city, amid the revels of feasting and wine. It has been suggested, that he died by poison, which had secretly been administered amid his draughts of pleasure and excess; but whatever might be the cause of his death, he was prematurely cut off in the 32d year of his age. An event so unexpected, and such extensive conquests left without a head, naturally occasioned consternation, mingled with ambition, among the principal chiefs of Alexander.

After a pause of several days, Aristides, the brother of the late king, was raised to the throne; and if Roxana should be delivered of a son, it was appointed that he should reign along with him, to the exclusion of his brother Hercules, who was born to Alexander by the daughter of Darius; but these arrangements were of short duration; for Perdiccas, who had been a favourite of Alexander, assumed the regency, trusting to his address and influence for the establishment of his power. But this step raised violent commotions among the generals of Alexander; and after a battle which was fought in Phrygia, the empire of Alexander was divided into separate portions. Ptolemy Lagus, who was afterwards denominated Soter, was entrusted with the government of Egypt.

It was in the year 368 that Ptolemy took upon him the sovereign authority in Egypt; and though he was not till afterwards honoured with the name of king, yet he was under no control, and he exercised his power for the good of the state. Having added Palestine, Syria, and Phoenicia to his new dominions, he proceeded to acquire Cyprus, which abounded with wood, for the building of ships; but he was interrupted in these proceedings by the invasion of Antigonus, whose capital was Babylon, and whose possessions were immense. He made a successful inroad into the dominions of Ptolemy; and Gaza, Joppa, and Tyre, were subdued. After various struggles, and interchanging successes between Antigonus and Ptolemy, the former was slain in battle, and his son Demetrius, after various reverses, was taken a prisoner of war, and retained a captive till he died. Ptolemy Soter was of a literary character, as well as a skilful and intrepid general. He wrote the life of Alexander the Great, which was lost amid the ravages of time; but from comments and observations which remain, it appears to have been elegant and much esteemed.

His taste for literature, and his love of science, appeared in the exertions which he made to promote knowledge and enquiry. He founded a college or museum, which became the asylum of learned men, and he formed a library, to assist the cultivation of science. Among the men of learning who flocked to Alexandria upon the invitation of Ptolemy, was Demetrius Phalaris the Athenian. He was a wise and a favourite governor in that city; but upon Athens being taken by Antigonus, the people received the conqueror with extravagant demonstrations of
joy, and they banished Demetrius with threatenings of death. In this situation he fled to the court of Ptolemy, deeply afflicted with the changeable temper, the ungrateful and hasty proceedings of the populace, when the government is invested in their hands. The accomplished Demetrius took charge of Ptolemy's library, and assisted his royal master in literary arrangements.

The munificence of Ptolemy was manifest in the splendid buildings of the museum, as well as in the magnificent temple which he reared for Serapis in Alexandria, and in the watch-tower of Pharos, which he constructed for the commercial interests of the country. In the mean time, Ptolemy Soter was far advanced in years; and, by the influence of his favourite wife Berenice, his son Philadelphus was nominated his successor, to the prejudice of Ceraunus his eldest son.

Ptolemy Philadelphus obtained full possession of the throne, upon the demise of his father; and his accession was celebrated with uncommon splendour. At this time the empire of Asia was engaged in war, by Seleucus and Lysimachus, the only surviving generals of Alexander the Great. Ceraunus, the elder and disappointed brother of Ptolemy Philadelphus, had left Egypt, either from choice or necessity; and he took an active part in the wars which were subsisting between Seleucus and Lysimachus. By his artifice, the ruin of Lysimachus was accomplished; and then he put Seleucus to death with his own hand. Having perpetrated these deeds, and being supported by a multitude of adherents, he obtained the throne of Macedonia; but just retribution soon overtook him, for he was slain in battle, and his dead body was treated with indignity.

During the reign of Philadelphus, the Romans attracted the public notice, in their disputes with the city of Tarantum; and the king of Egypt solicited their friendship. Hence a close alliance was formed between the courts of Rome and Alexandria. Ptolemy Philadelphus attempted to assist the Greeks, when they were invaded by the Macedonians; but the assistance he granted was unsuccessful, and his affairs at home assumed a gloomy aspect. His brother Magas, who was governor of Lybia and Syria, took advantage of his perplexing condition, and, by the assistance of his father-in-law Antiochus Soter, king of Upper Syria, he attempted to wrest the kingdom of Egypt from the hands of Ptolemy Philadelphus. During these preparations, and while the king of Egypt was employed abroad, there was a revolt in the bosom of his kingdom, by 4000 Gauls whom he had employed in his service; but overcoming all these difficulties, he finally established his throne. From fear, or a sense of duty, his brother Magas was desirous of being at peace with Ptolemy; and, as a bond of union, proposed that his daughter Berenice should be united in marriage to Ptolemy the son of Philadelphus, that the possessions of both brothers should at length centre in one family. This proposal was carried into effect; but in the mean time Magas died, and did not see the marriage solemnized. This settlement was opposed by Apamin, the mother of the young princess; and she stirred up Antiochus Soter to declare war upon Egypt. But the threatening storm passed away, and Ptolemy Philadelphus was left at peace.

This sovereign of Egypt built many cities, and erected various temples. He had even a share in constructing the celebrated Pharos of Alexandria; for that watch-tower was built in the latter end of the former reign, when he was united with his father in the kingdom. He finished the canal from Suez to the Nile, and watered the deserts of Lybia by reservoirs and ductile streams. The court of Philadelphus might be called the seat of learning and politeness; for strangers and the unfortunate were received with courtesy, learning flourished, and books were increased. But where is the perfect character? and we find a considerable stain upon the conduct of Ptolemy the Second. Demetrius Phalaris, the friend and confidant of his father, had counselled the old king not to retire from the government, and to nominate his eldest son Ceraunus to the succession. A different destination was obtained, as we have seen, by the influence of Ptolemy the Second's mother; and the young prince, not forgiving the counsel of that venerable man, cast him into prison after the death of Ptolemy Soter, and suffered him to die by the bite of a scorpion. Philadelphus at length being far advanced in years, and much afflicted by the death of his Queen Arsinoe, sunk under the infirmities of his constitution, and only survived her a few months.

Ptolemy III, and eldest son of the late king, was invested with the powers of government; but his reign was opened with a severe though prosperous war. No sooner had Antiochus the king of Syria heard that Ptolemy Philadelphus was dead, than he divorced the Egyptian Princess Berenice, and dismissed her with her infant son. Having recalled his former Queen Laodice, she shewed herself unworthy of the favour, for she conspired against the life of her indulgent husband; and upon his death raised her eldest son Seleucus Callinicus to the throne of Syria. No sooner were these proceedings known at the court of Egypt, than Ptolemy marched with an army to avenge his sister's wrongs; but he was too late to save Berenice's life. The conduct of Laodice, however, had rendered her odious to the Syrians, and Ptolemy inflicted upon her the reward of her crimes. Seleucus was banished from the kingdom, and the dominions over which he reigned submitted to the power of the Egyptian king.

In process of time, Seleucus recovered some of his revolted possessions; but in attempting to regain the whole, he was defeated by Ptolemy, and forced to retire to Antioch without an attendant. To deliver himself from this situation, he applied to his brother Antiochus, who had then the command of an army, which he had attached to his interests; but having made peace with Ptolemy, his brother was dissatisfied, and opposed the interest of Seleucus. But his brother Antiochus was reduced by a series of calamities; and Seleucus having acquired additional power, endeavoured to overthrow the rising influence of Arsaces. This man being governor of Parthia, took advantage of the disasters which were prevalent in the kingdom; and he attached to his interest many of the soldiers, as well as of the people. It was in vain that Seleucus attempted to counteract his influence; and he laid the foundation of the famous Parthian empire, which continued in the family of Arsaces for many generations.

Ptolemy III was a successful as well as a warlike prince, and, as appears from a monumental inscription, he not only subdued the provinces which lie on this side of the Euphrates, but crossed that river, and conquered Mesopotamia and various small kingdoms, which extended as far as Bactria. As he was returning from this expedition, he visited Jerusalem, which was then tributary to Egypt; and, amidst many expressions of affection for the people of Judea, he offered up sacrifices to the God of Israel. Onias, the high priest, had neglected for many years to pay the tribute, and soon after his return
to Egypt, Ptolemy sent a messenger to demand the ar-
rears. But indeed the tribute of Phcenicia and the neigh-
bouring provinces had also been neglected, and a sum-
mons was everywhere issued requiring payment of the
debt. Deputies arrived from various places to obtain an
accommodation; but Joseph, the nephew of the Jewish
high priest, discovered so much integrity and unaffected
plainness of dealing on his mission, that he not only ob-
tained the most favourable terms for his country; but
was also entrusted with the power of levying the tribute
from all the adjoining provinces.

Ptolemy had raised the kingdom of Egypt to a very
commanding height of power; for, besides his immense
influence by land, he was powerful at sea, and had ex-
tended his conquests to the straits of Babelmandel. His
assistance was requested by the members of the Achaean
league; but Aratus having formed a connection with
Antigonus of Macedon, Ptolemy was offended, and lent
his aid to Cleomenes king of Sparta. But his new ally
being defeated and overthrown in the battle of Sellasia,
flled into Egypt, and received protection. Amid the spoils
which Ptolemy acquired in his Eastern conquests, be-
sides immense sums of gold and silver; he recovered a
prodigious number of statues; gold and silver shrines
and images, which Cambyses had carried away from the
temples and palaces of Egypt. These valuable and re-
vered relics Ptolemy returned to their proper places;
and hence he was stiled Euergetes, or the Benefactor.

While Ptolemy Euergetes was absent on these expe-
ditions, his affectionate Queen Berenice was alarmed for
his safety; and vowed, if he should be restored to her
wishes, she would consecrate her hair in the temple of
Zephyrium. Ptolemy returned, and the sacrifice was
made; but by some accident, the consecrated hair was
lost. The king was offended, and the priests were in
danger; for the female hair was the chief ornament of
the Egyptian as well as the Eastern ladies; and the sa-
crifice had acquired an additional value, because it was
consecrated as a monument of Berenice's affection for her
lord. But the superstition of the times, and the address
of Conon, the celebrated mathematician of Samos, de-
dered the priesthood from their fear. In those days,
heroes were deified, and sometimes had a place assigned
them in the starry heavens; but Conon's fancy took a
wilder flight, and affirmed, that the consecrated hair of
Berenice had been translated to the firmament, and com-
pared the seven stars in the tail of Leo.

Ptolemy Philopater, whose father Euergetes died in the
27th year of his reign, ascended the throne of Egypt in
due order of succession. Toward the commencement of
his reign, Antiochus, the King of Syria, attempted to wrest
from the hand of Ptolemy, the eastern provinces, which
had so long been objects of contention. In this, however,
he was disappointed; and if the new king of Egypt had
possessed the vigour and genius of his father, he would
have driven Antiochus entirely out of Syria. But he
was deeply immersed in pleasures, and, by excesses of
dissipation, lost his dignity, and paved the way for re-
bellion at home. His queen, Arsinoe, was distinguished
for military ardour; and having accompanied her lord
to the field of war, she frequently shewed her spirit, by
riding along the ranks, and animating the men to battle.
And though the armies of Ptolemy obtained several vic-
tories, and the kingdom of Egypt suffered no diminution of
extent; yet it became feebie at home, and the present
reign terminated in the midst of disorders.

When Ptolemy was at Jerusalem, he attempted by
force to enter into the most holy place of the Jewish
temple; into which none but the high priest, and that
only once a year, was permitted to enter. Being for-
cibly prevented from accomplishing a wish, which was
sacriliege in the eyes of the Jews; he became frantic with
rage, and returned to Egypt, determined to wreak his
vengeance on the Jewish people, who had hitherto en-
joyed many indulgences in the kingdom of the Ptolemyes.
He instantly published a decree, putting every Jew with-
out the protection of the law, who should refuse to com-
ply with the rituals and substance of the Egyptian wor-
sip, and at the same time he offered protection and ho-
ners to those who should worship the gods of Egypt.
Few of them were indifferent or profane enough to for-
sake the religion of their country; and his wrath rising
to a greater height, he resolved to extirpate the whole
Jewish people.

For this cruel purpose, he commanded those of Alex-
andria to assemble in the Hippodrome or place of public
diversion; and he collected 500 elephants for the de-
struction of that devoted people; but these enraged ani-
mals rushed upon the crowd of spectators instead of the
Jews; and many who had assembled from curiosity were
put to death. In short, the reign of Ptolemy was alto-
gether feeble; and the latter part of it unjust and cruel.
The affairs of Greece were now placed in that situation,
that Cleomenes, the king of Sparta, conceived it to be a
proper time for him to return and retrieve his affairs.
He had continued in Egypt from the reign of the for-
mear king, with many professions of affection, and pro-
mises of aid; but his request was now absolutely refused,
and he was treated with severity by the Egyptian go-

gernment. Frantic with disappointment, and mad with
despair, he attempted to instigate a rebellion in the ca-

cital of Egypt. Having acquired some adherents, he

sallied forth into the streets of Alexandria; but being

drowned by the guards and soldiers, many of them

were slain; and those who survived, put one another to
death, in order to avoid public disgrace.

Besides his unfeeling conduct in refusing assistance to
Cleomenes, his reign is tarnished by many cruel acts.
Soon after his accession to the throne, his brother Ma-
gas and Berenice his mother were basely put to death.
His wife Arsinoe was so completely disgusted with the
conduct of the king and the court, that, after having tried
every scheme to rectify the public and private abuses,
she prayed that an end might be put to her existence.
The wicked Sosibes, who was the king's favourite, de-
vised means for complying with her demand; but it is
not to be supposed, that he durst have ventured upon
such a step, if he had not been well assured, that her
death would be acceptable to the king his master. Pto-
lemy Philopater sunk at last under a ruined constitution,
and died in the 87th year of his age.

Ptolemy Epiphanes, the only son of the late king,
was but five years old when his father died; and it re-
quired some skill, as well as bold efforts, to protect him
from dangerous designs, and fit him for the important
station which he was destined to fill. Agathocles at-
tempts, upon the death of the king, to have the ma-
agement of the young prince, and the direction of pub-
ic affairs. For this purpose, she called to her aid her
brother Agathocles, and engaged their creatures and mi-
nions in the service; but the indignation of the people
was roused by so base an attempt. Agathocles was the
favourite of the late king, and was not considered as
innocent of the despair and death of the queen. There- 
fore she and her unworthy associates fell victims to
the popular fury, and the young prince was proclaimed
king.
In the former reign, the Romans had renewed their
friendship at the Egyptian court; and the adherents
of young Ptolemy on this occasion applied to Rome for
assistance and direction. This was the more necessary,
because the infancy of Ptolemy required protection;
and because Antiochus and Philip of Macedon had
determined, in the feebile state of the Egyptian
government, to dismember that empire, and divide it amongst
themselves. The aid of the Roman government was
given with readiness and effect. An ambassador was sent
from Rome to each of the confederated hostile kings, and
M. Aemilius Lepidus hastened to Alexandria to manage
the affairs of the Egyptian court. Having placed them
in a state of proper direction, he returned to Rome,
and set the prudent Aristomenes at the head of
the Egyptian government. Finding the Egyptian army
disorganized, as well as the court dissolved in dissipa-
tion, he resolved to inspire a new spirit into the soldiery;
and for this purpose, he engaged in the service of
Egypt 6000 Grecian troops, under the command of
Scopas, a general of Ætolia.
The Macedonian king having been invaded and kept
in check by the Roman armies, had neither the means
nor the opportunity of annoying Egypt; but Antiochus,
the king of Syria, seized upon Palestine, together with
the adjoining provinces, which had been conquered
by Ptolemy; and though he was driven back by the troops
of Scopas, yet he recovered his former conquests. With
the apparent view of a permanent friendship with
Egypt, he proposed to bestow his daughter, Cleopatra,
upon the young king, and to give, as her portion,
those provinces, which had been so long objects of con-
tention and war between him and the Egyptian king.
But nothing could be more remote from his intentions
than the serious fulfilment of this proposal; for his nu-
merous successes had fed his ambition, and he seemed
to aim at universal monarchy.
Upon a report prevailing that Ptolemy Epiphanes was
dead, Antiochus sailed with a fleet to invade the country;
but the news was unfounded, and he directed his course
to Cyprus. Here he was repulsed, and escaped with
but a small remnant of his fleet. The Romans obser-
ving the views of Antiochus, and being desirous of ex-
tending their own dominion, attacked this sovereign
with consummate skill, and forced him to surrender
not only his conquests in Europe, but to abandon all
that part of Asia Minor, which lay to the west of
Mount Taurus. After the Egyptian king had taken
the reins of government into his own hand, he received
the daughter of Antiochus in marriage; for the Syrian
king wished to strengthen his hands against the en-
croaching power of Rome in the East. But Ptolemy
was feeble at home, and inefficient abroad. He renewed
an alliance with the Achaean league; but his whole
reign was a series of disasters. The king was corrupt,
and the people were disaffected; the court was treacher-
ous, and his generals were insinuere. Under Scopas
the Eolian, one conspiracy was formed, and though it
was detected, another more formidable was contrived;
and though it too was discovered and overcome, yet the
seeds of discontentment and revenge were so cherished
by the perfidy and violence of the king, that his ene-
mies increased, both in numbers and resolution, till he
was cut off by poison in the 29th year of his age.

Upon the death of Ptolemy Epiphanes, Queen Cleo-
patra assumed the regency; for her son, the heir to the
throne, was but six years of age. Her firm and judi-
cious conduct rendered the administration of public
affairs quiet and successful. The disputes between
Syria and Egypt, were either temperate or wholly sus-
pended; for Seleucus, who had succeeded his father,
was the brother of Cleopatra, who managed the affairs
of Egypt. But Seleucus died, and was succeeded by
his brother Antiochus, who assumed the surname of
Epiphanes; but his character was base and illus-
trious, as the name would intimate. In the mean time
the queen regent of Egypt died, and the young king
was called to the throne as he entered upon the 15th
year of his age. In this situation of public affairs, the
uncle of the young king marched an army into Egypt,
and got possession of the frontier towns.
The winter was spent in mutual preparations; but
Antiochus invaded Egypt in the spring, and became
master of the whole country, excepting the city of
Alexandria. Ptolemy himself was taken prisoner; and,
after a variety of changes, was nominally declared to
be the sovereign of Egypt. Finding that Egypt was
really under sujeetion to Antiochus, and that the young
king was only a prisoner of state; the city of Alexan-
dria raised his younger brother Ptolemy to the throne,
whom they surnamed Euergetes the Second, to distin-
guish him from the captive king, who was Ptolemy Phi-
لومeter. The conduct of Antiochus brought the two
Ptolemies to a mutual understanding; and they united all
their resources to oppose their ambitious and unnatural
uncle. Still, however, he persisted in his scheme, and
they were in danger of being overwhelmed, when an
embassy from Rome arrested the progress and designs
of Antiochus. The successes of the Roman arms, and
the growing fame of the nation, overawed the king of
Syria, and relieved the Egyptian government. But
the harmony of the two brothers did not long remain.
Dividing the empire, Lybia and Cyrene were ceded
to Ptolemy Euergetes, and the rest was retained by Pto-
lemy Philometer. The former of these districts formed
the island of Cyprus; and when the claim could not be adjusted
between the brothers, the Roman senate favoured the
pretensions of Ptolemy Euergetes; still, however, Phi-
لومeter resisted; and, during the course of the struggle,
his rival brother was taken prisoner. Ptolemy Philometer
restored him to liberty, and gave him back his part of
the kingdom, together with an advantageous substitute
for the island of Cyprus. Thus the brothers were at
peace and friendship with one another; but the reign
of Ptolemy Philometer was not suffered to remain in
tranquility. On the death of the Syrian king, a suc-
cession of changes took place in the management of
the empire; and Alexander Balas, a young adventurer,
usurped the throne of Syria. This sovereign obtained
the daughter of Ptolemy Philometer in marriage; but
so unworthy was he of this alliance, or the throne to
which he was raised, that Ptolemy espoused the cause of
his competitor Demetrius Nicator, and gave him his
dughter, who was married to the unworthy Alexan-
der. In a short time, Ptolemy Philometer died at the
age of forty-one.
Upon the death of Ptolemy Philometer, his Queen Ptole-
my Cleopatra assumed the management of public affairs,

History.

Ptolemy VI. B.C. 181.
the Roman ambassadors, Euergetes and the queen regent were united in marriage, and the son of the late king was to ascend the throne on his uncle's demise. Such an arrangement appeared to be wisely calculated to preserve harmony and order; but can it be believed, that during the marriage festival, the new king stabbed the infant prince in the arms of his mother. Ptolemy was inauspiciously denominated Euergetes, for he was a monster of cruelty and vice, and afterwards received the surname of Physcon, on account of his corpulence and unseemly figure.

From the horrible commencement of his reign, nothing was to be expected but cruelty and crimes. He wantonly banished, or put to death, the principal inhabitants of the kingdom; and the people at large were exposed to insults and destruction. During these scenes of unequalled cruelty, the men of science, who had been cherished in the college of Alexandria, fled from the kingdom; but they carried with them important discoveries and much valuable knowledge into foreign countries and foreign climes. Having invited strangers to settle in Egypt, and found that they also were impatient of his tyranny, he let loose his mercenary troops upon multitudes of people, who were assembled on purpose for his revenge, and unfeelingly put them to death. But being terrified at the popular rage, he left Egypt and sailed to Cyprus.

But previous to this, he had divorced his Queen Cleopatra, and forced her daughter to receive him in marriage. But, how shall we obtain credit for the cruel, nay mad conduct which he now pursued? Finding that his divorced queen had been raised to the throne of Egypt, his fury exceeded all bounds; he murdered his son Memphites, whom she had born to him in marriage, and sent the mangled carcass to afflict the feelings of a mother, already too much agitated and torn. Having raised a well-appointed army, the kingdom of Egypt was soon subdued by his power, and Cleopatra took refuge in Syria, with her daughter and Demetrius the king. Enraged at Demetrius for the protection which he afforded Cleopatra, he raised up Zebina, a citizen of Alexandria, to be a competitor for the throne of Demetrius; and though this youth had no just pretensions to the government, yet upon the ruin of Demetrius, he obtained the Syrian empire. From this time forth, there was no further knowledge of the exiled queen; and after a reign of 20 years, the detestable Physcon finished his earthly career. During the contest which he maintained with his brother, the Roman senate espoused his cause, though toward the close of the competition, they saw reason to support the pretensions of his brother Philemon. When he obtained the throne of Egypt upon the death of this king, the Romans could not fail to see and detest his character. Their intercourse with Egypt was then but slight and casual, but, considering the value of the country, and the disordered state of Ptolemy's government, they appear to have entertained some thoughts of rendering Egypt a province of Rome.

The kingdom of Egypt, which had been long feeble and convulsed, was now more than ever in a precarious and dangerous condition. Ptolemy Physcon had left three sons, Appion, Lathyrus, and Alexander; amongst whom it was highly probable there would be competition and intriguing for the crown; for in Egypt the rules of succession had not been well ascertained, and in various instances, capricious claims had been admitted. Though Appion was illegitimate, he might have aspired to the sovereign power; yet he appears to have been satisfied with the province of Cyrene, and retired in peace to the seat of his government. Lathyrus, it is believed, ascended the throne of Egypt in the order of succession; but the Queen-mother Cleopatra, having sufficient influence to maintain an ascendancy in the government, dismissed Lathyrus to the island of Cyprus, and raised Alexander his younger brother to be her associate on the throne. But so agitated was the state of Egypt, so arbitrary the conduct of Cleopatra, and so varying the interests of these two princes Lathyrus and Alexander, that they were alternately raised to the throne, and dismissed, by their mother's influence, to the more humble situation of governors of Cyprus.

Alexander appears to have been the favourite of his mother; but the preference seems to have been given, because he was more subservient to her will: for no virtuous affection could have influence in the breast of a woman so ambitious and base as Queen Cleopatra. She and Lathyrus were not only at perpetual variance about the affairs of Egypt; but each of them took a part in the interests of Syria, which were a subject of contention between Antiochus of Cyzicus, and his brother Grypus. Each of them employed the influence which their Syrian conquests afforded them, for the purpose of overthrowing each other's power in Egypt. Lathyrus at length prevailed; but his success was more owing to other causes than his own prudence or superior skill.

The conduct of his mother was so shameful and void of principle, that his brother Alexander, notwithstanding all his forbearance, was at length wearied with her crimes, and retired in disgust. He was invited by the queen to return to his duties in the state, for the nation would not be satisfied with her government alone. When he did return, she conspired against his life; but the conspiracy was detected, and she was herself cut off by cruel and unjustifiable means. It could not be disguised that the mother was put to death at the instigation of her son, and though his character was detestable, and self-preservation might be pleaded in his favour, yet to encompass the death of a parent was a crime which could not be forgiven, even by the dissolute and degraded Egyptians. Therefore Ptolemy Alexander was compelled to fly from Egypt, and his brother Lathyrus was recalled to the throne. Scarcely was he invested with the powers of the kingdom, when the affairs of Upper Egypt demanded his attention. You must have observed, that for a series of years the kingdom of the Ptolemies was almost dissolved by contensions and mist ature; and we are not to be surprised, that the remoter parts of the empire should wish to obtain independence and quiet. It is unnatural to suppose that Thebes could be contented with her forlorn condition. She had long been the mistress of Egypt; her glory had been at length tarnished, by the state of government being removed to Memphis, and now that it was carried to a still greater distance in the lately erected city of Alexandria. The whole strength of the government being unmoved, it could scarcely be deemed culpable that she should attempt to become again the habitation of a court, and the head of an independent kingdom. It was natural for Lathyrus, too, to retain his subjects within the influence of his government, and it was a legitimate enterprise to adopt measures for reducing Upper Egypt to its former allegiance. The insurgents were resolute in their defection; and Lathyrus, with culpable severity, reduced the ancient and venerable city of Thebes to a heap of ruins, where the voice of joy and of gladness was never more to be heard. But
Lathyrus himself did not long survive this melancholy
triumph, and he left his kingdom to increase in evils,
and endure greater degradation.

Cleopatra.
B. C. 81.

Cleopatra, the daughter of Ptolemy Lathyris, had
the only legitimate claim to the crown, and she was in-
stantly proclaimed the sovereign of Egypt. Being gentle
and conciliating in her manners, they expected a happy
reign; but there were events in preparation which dis-
appointed their hopes, and exposed Egypt to a long
train of anarchy and sufferings. Rome, from being the
ancient ally of the Ptolemies, had gradually acquired an
influence in the state; and at this time the senate sup-
ported the pretensions of Alexander, the son of Ptolemy
Alexander, late king of Egypt. While his grandmother
Cleopatra, during the last reign, was taking an interest
in the affairs of Syria, she took her grandson along with
her as she embarked for Phoenicia; but left him, to-
gether with her jewels and valuable stores, in the island of
Cos. The whole of these deposits fell into the hands of
Mithridates the Parthian, from whom the young prince
Alexander escaped, and took refuge in Rome.

Sylla, who was then perpetual dictator, supported his
pretensions to the kingdom of Egypt; and coming from
so powerful a quarter, the recommendation could not be
slighted. To make the best accommodation that the
circumstances of the case permitted, it was finally
agreed that Cleopatra should marry Alexander, and that
they should reign together on the throne of Egypt.

But Ptolemy Alexander was too ambitious to have any
partner in the government; and, according to the rude
and corrupt practices of those times, the young and
amiable queen was cruelly put to death. This detesta-
ble crime excited the hatred of his subjects; and, after
a variety of unavailing attempts to suppress his enemies,
he found it necessary to flee from the country. He
took refuge in Syria under the Roman general Pompey;
but seeing no prospect of being restored to Egypt, he
departed to Tyre, where he soon died, and bequeathed
Egypt, as well as Cyprus, to the Roman people.

Upon the deposition of Ptolemy Alexander II. a son
of Ptolemy Lathyris was admitted to the throne, who,
on account of his attachment to music, and skill in play-
ing the flute, was denominated Auletes. But his char-
acter possessed none of those qualities which were ne-
necessary for restoring Egypt to order and obedience.
He appears to have been frivolous in his manners, and
though a sovereign, yet he contended publicly for the
musical prize. The power which Rome had acquired,
rather than the senate formidable to their neighbours;
and Auletes was desirous of obtaining their approba-
tion to his succession in Egypt. The Romans had habitual-
ly acquired an influence in Egyptian affairs; and he
was the more anxious to secure their approbation, be-
cause they had obtained a show of right to the king-
dom of Egypt, by the will which Ptolemy Alexander
had left in their favour.

Though it was not expedient that the Romans should
openly lay claim to the kingdom of the Ptolemies, yet
there was a general unwillingness to sanction the ac-
cession of Auletes. But Cesar, the consul, being deep in
debt, he and Pompey, who was also venal, were gained
to the interests of the Egyptian king, and the Roman
people received him as their ally. In the mean time,
the brother of Auletes was appointed king of Cyprus;
but having offended Closius, a Roman naval com-
mander, he was deprived of the kingdom, and Cyprus was
united to the Roman republic. The facility with which
Ptolemy Auletes had suffered the island of Cyprus to
be separated from the Egyptian dominions, gave great
offence to his people; and being otherwise obnoxious,
both by the meanness of his character, and by the ra-
pacity which he exercised to repay the money which
he had borrowed to lavish upon the leading senators
of Rome, in order to obtain their approbation and sup-
port, rendered him so completely detestable, that his
army deserted his standard, the people were tumultu-
ous, and he was compelled to flee for his life. In this
situation he looked to Rome for assistance, and on his
passage to Italy he landed at the island of Rhodes, and
there he met the celebrated Cato.

That solid and deep-thinking republican blamed his
conduct for leaving Alexandria; and persuaded him to
return without going to Rome. He might find means
to satisfy the discontent of his own people; but the
value of Egypt itself, said Cato, will not satisfy the
avidity of the degraded senators of Rome. He pro-
ceeded, however, to the Roman metropolis; but Caesar,
whose friendship he had obtained, and from whom he
expected support, was abroad on his military appoint-
ments in Gaul. But his cause was taken up, and his
name was perpetuated by the celebrated Pompey, who
had been assisted by the Egyptian king in his war
against Mithridates. He was treated, however, with
greater favour, because Pompey was bound to his in-
terests, by the profusion of gold, which Ptolemy distri-
buted to procure the support of the more active and
leading senators.

In the mean time, a numerous embassy arrived from
Alexandria to state the Egyptian complaints, and op-
pose the restoration of Ptolemy Auletes; but the fugi-
tive king found means to cut off the ambassadors, with
the learned Dion at their head; and, by bribery and
corruption, obtained the forgiveness of the senate for
what he had done. At the same time a decree was
passed for restoring Ptolemy to his kingdom; but by
the address of his enemies, and the superstition of the
people, an oracular response was obtained and acted
upon, by which it was forbidden to employ Roman
soldiers for restoring the Egyptian king. But the en-
terprise was too lucrative not to be undertaken by the
avaricious servants of the Roman republic. By Pome-
py’s advice, Gabinius, the Syrian proconsul, under-
took the business for the reward of 10,000 talents, or
nearly two millions of British money. Under his di-
rection, Mark Antony passed the desert, and, by the
assistance of Gabinius, replaced Auletes upon the throne
of Egypt, though not without much resistance and
blood.

When Ptolemy Auletes fled from Egypt, his daugh-
ter Berenice was invested with the regal power, and
married to Seleucus, a king of Syria. This marriage
was accomplished to add the strength of Syria to the
Egyptian power; but the connection was unfortunate
and transitory. It was Antiochus of Syria whom the
Egyptians desired for the consort of their queen; but
he having died prematurely, his brother Seleucus was
invited to be her partner on the throne. He was no
less distorted in the dispositions of his mind, than he
was unseemly in his personal appearance. Among
other vices, he was covetous in the extreme, and violat-
ing the sanctions of the dead, which was peculiarly
sacred among the Egyptians, he seized upon the gold-
en coffin in which the body of Alexander the Great
had been deposited, and put in its stead one of inferior
value. By these and other means he became obnoxious
to the people, and so detested by the queen Berenice
that, according to the practice of those ruder times, she
devised means, and put him to death. Then she mar-

Flees to

Rome.

Queen Bera-

niece.
ried Archelaus, high-priest of Comana, who was also an able warrior, and was the Egyptian leader, who resisted with so much boldness Gabinius and Mark Antony, when they entered Egypt to restore Ptolemy Auletes.

The money paid to Gabinius was borrowed from Caius Rabirius Posthumius, and he naturally expected payment when Ptolemy had recovered the resources of his kingdom. But the Egyptian king was in every respect worthless and vile. He devised means to cast Gabinius into prison, and the unhappy high dignitary, having escaped from confinement, returned to Rome, and was prosecuted by the senate for having degraded the character of a Roman knight, and for having been engaged in scenes of bribery and corruption. By the eloquence of Cicero he was acquitted of the crimes; but Gabinius, who was the chief instrument of restoring Ptolemy, was found guilty, and condemned to perpetual banishment; but was recalled by Caesar when he obtained the sovereignty of Rome. No sooner was Ptolemy Auletes settled upon the throne of Egypt, than he put his daughter Berenice to death, whom the people had constituted queen, and he was guilty of oppression in every form. But his death ensued after a period of four years; and he left his two sons and two daughters to the care and tuition of the Roman people.

Ptolemy Dionysius was the legal successor to his father in the kingdom; but being too young for managing the affairs of state, he, and the other children of the late king, were under the superintendence of the Roman senate, and the government of Egypt was also conducted by them. But as soon as the young prince was thought to be capable of managing the state, he was admitted to the throne; and he associated with him, in the government, his sister Cleopatra. But their friendship and union were of short continuance; and each having their partisans, a civil war ensued. During the occurrence of these events, the affairs of Rome had suffered wide and important changes. Julius Caesar, a popular and ambitious leader, employed the power which he had obtained, both in his army and amongst the people, to overthrow the Roman republic, and raise himself to the sovereign power. Pompey stood foremost amongst the numbers, who hated and opposed the encroachments of Caesar; but he was daily losing ground, whilst the other as regularly was increasing his influence; and at length, in the battle of Pharsalia, Caesar conquered, and Pompey was put to flight.

In terror of pursuit, and without protection, he directed his course to Egypt, where he hoped for a ready and welcome reception; because, through his influence and schemes, Ptolemy Auletes, the late king, had been restored to his kingdom; but he was betrayed and put to death. The counsellors of the young king were either afraid of giving offence to Caesar, or they were suspicious that Pompey, even in his fallen state, might regain some of that influence which he formerly possessed in Egypt; and either lessen their power with Ptolemy Dionysius, or espouse the cause of Cleopatra, who was now driven from the kingdom; and therefore, without justice or feeling, Pompey was beheaded as he landed on the shore.

Immediately after the victory of Pharsalia, Caesar paraded Pompey; and, with a chosen band of soldiers, landed at Alexandria. There he found his enemy had been put to death, and being presented with his head, he was much afflicted; and instead of being gratified, as the assassins supposed, he wept at the sight, and commanded the remains of Pompey to be honoured.

The kingdom of Egypt, which had long been agitated by intestine divisions, was now in a state of turbulence and misery. Cleopatra, with some of her adherents, fled into Syria, and Ptolemy had assembled an army between Pelusium and Mount Cassius, in order to oppose Cleopatra, who was returning to Egypt with an armed force. On the frontiers, every thing was warlike; in the interior, all was confusion. In the capacity of guardian to the children of Ptolemy Auletes, Caesar being then invested with the supreme authority of Rome, commanded a statement to be laid before him of the differences which continued to agitate the kingdom, that he might pass sentence thereon, and compel the parties to abide by his decision. The power of Caesar was too great to have his will opposed; and therefore advocates for each side were chosen, and every arrangement made to have the matters in dispute brought to an issue. But Cleopatra, being anxious for the success of her own claims, and aware what influence her presence and personal charms might have upon Caesar, set out from Phoenicia, and arriving in the bay of Alexandria, was secretly conveyed into the presence of Caesar.

Ptolemy, having discovered his sister's arrival, was frantic with rage at her access to the arbiter of his destiny, and the whole city was in commotion. To avert the storm which was gathering, and restore the people to confidence, Caesar passed a decree, that Ptolemy Dionysius and his sister Cleopatra should reign jointly upon the throne. And further to conciliate the affections of the people, he restored the island of Cyprus, and submitted its government to the younger son and daughter of the late king. But the friends of Ptolemy were suspicious of Cleopatra's power, especially as she was obviously the favourite of Caesar, and could support her interests by the power of Rome. At the instigation of Photinus, Achillas, the commander in chief, filled the city of Alexandria with troops, and attempted to block up the harbour, that he might thereby cut off the Roman supplies. The attempt was frustrated by burning the Egyptian ships; but the flames reached a part of the city, which was called Bruchium, and its noble library was destroyed. Photinus, the fomenter of these evils, was put to death; but Ganymedes, his associate, a deep designing man, continued to maintain the strife, and combat the Romans.

On various occasions, Caesar was in imminent danger; and upon a time while he was hastening from the Mole of the Pharos, the boat in which he was passing sunk by an over-pressure of soldiers, who fled from pursuit. But Caesar swam to a neighbouring vessel, and his life was preserved. Upon a promise of peace, the king of Egypt was liberated from that bondage into which Caesar had thrown him, while he had drawn the sword against him and Cleopatra. But all his promises were soon violated; and the war acquired new strength from the presence of the king. But the Roman discipline and address overcame the numbers, as well as the rancour of the Egyptians; and Ptolemy himself perished while crossing a bracer of the Nile.

A fair opportunity now occurred of Cleopatra obtaining the sovereign power; but Caesar, attending to the prejudices of her people, joined with her in the government her younger and only surviving brother, who had been formerly appointed to the government of Cyprus. But this nomination was a mere show of limiting the power of Cleopatra; for the young prince
EGYPT.

was but in the eleventh year of his age; and, according to the accredited maxims of those times, he was soon put to death by treachery and poison. His younger sister Arsinoe was sent to Rome, that she might acquire no partisans, nor be the means of any disorders in Egypt.

Cæsar, captivated with Cleopatra.

Hitherto Cæsar had continued in Egypt with the professed intention of settling its affairs; but his remaining at Alexandria after Cleopatra was seized firmly upon the throne, only served to alienate and degrade his attachmment to the queen. In various parts of the Roman dominions, the power of Cæsar was threatened; but he could not be induced to leave Cleopatra till his fortune seemed to be upon the verge of despair. Then his usual activity returned, and from place to place he carried victory and triumphs. Having suppressed the insurrections in Syria, he hastened to Africa, and overthrew the partisans of Cato, and the king of Numidia, in the celebrated battle of Thapsus. Then, having conquered the remainder of Pompey's party in Spain, he returned to Rome, and enjoyed for a while the fruit of his triumphs. But still his affections centered in Cleopatra; and it is said that he had taken some steps to remove an obstacle, which the Roman law placed in his way, for making her his wife. But the Roman people were still dissatisfied with arbitrary power; and Cæsar having become more unpopular, by repeated acts of licentiousness and severity, was murdered in the senate house.

Cæsar's death.

A scene of confusion now ensued at Rome, and it was difficult to say what hardships were to be endured, or what form of government was then to be adopted. Antony, Lepidus, and Octavius, who had assumed the name of Octavianus, formed a coalition, with the professed intention of avenging Cæsar's death; but chiefly with the view of aspiring separately to the sovereign power. Consequently the triumvirate was soon broken, and Lepidus falling into neglect, Antony and Octavius strove for the mastery. But Antony was peculiarly conspicuous at the battle of Philippi, where the cause of the republicans was lost, with the lives of Brutus and Cassius.

Antony in power.

Victorious and full of hope, Antony departed to Syria; and viewing himself as the master of Rome, he travelled into Syria, which, with the other provinces of the East, was committed to his government; and having arrived at Tarsus, he commanded Cleopatra to leave Egypt, and appear before him.

Though the kingdom of the Ptolemies had lately been secured to her by the interest of Rome, yet it is obvious that she did not obey the commands of Antony to acknowledge his authority, but perhaps to pay respect to the avenger of Cæsar; and who knows, but the licentiousness of Cleopatra might induce her to expect another admirer in the Roman hero? The meeting of Antony and Cleopatra was splendid beyond example; they indulged in costly presents, and their feasting were numerous and extravagant. At her solicitation, and to remove every fear of a rival, her sister Arsinoe was put to death. Like Cæsar, Antony was lost amidst the fascinating manners of Cleopatra; and he divorced his wife Octavia, the most virtuous of women, to remove the jealousy, and enjoy the favours of the abandoned Cleopatra. Having subdued his enemies in the East, he returned towards Rome to oppose the growing power of Octavianus, which his own misconduct had tended to enlarge.

Had Antony marched directly to Rome, the power of Octavianus might have been overthrown; but being enamoured with effeminate pleasures, he listened to the voice of Cleopatra rather than the counsels of his wiser friends; and having hazarded a naval battle near Actium, his fleet was vanquished, and he fled first to Lybia, and then to Alexandria. But he was not to be consolated by the presence of Cleopatra, and the consciousness of her own errors disquieted the mind of that virtuous woman. She fled from the presence of Antony, and retired to a sepulchral under the tombs of her fathers. Previous to this, Octavianus had followed up his triumphs over Antony, and was then victorious in the city of Alexandria. Believing a report that Cleopatra had put an end to her life, and seeing himself upon the point of falling into the hands of his rival and inveterate foe, he fell upon his sword. But not having instantly expired, and finding that Cleopatra was still in life, he was conveyed to her retreat, and after an affecting farewell, immediately expired.

Cleopatra could no longer escape the power of Octavianus, and she attempted to win his heart, and gain her liberty; but her attempt was ineffectual: and though she was treated with many marks of apparent respect, yet she was still detained a prisoner, and she had good reason to believe, that the Roman conqueror intended her to complete his triumphs at Rome. She maintained an appearance of confidence and good spirits; but she had taken her resolution, and was determined to die. Although this was suspected, and she was strictly watched, yet she found means to obtain an aspic, by the sting of which her life was taken away.

Thus died Cleopatra, who, to the beauty and gracefulness of her person, added the charms of wit, extensive knowledge, and affable manners. She was the patron of letters, and added a valuable collection to the libraries of Alexandria. She was licentious and vain; but she was born in the midst of a dissipated court, and placed in circumstances peculiarly seductive. While we reprobrate her conduct, we regret that her lot was not more favourable to virtue, and that qualities which might have been pure and illustrious in another situation, had exposed her conduct to the reprobation and dislike of every virtuous mind. See Maneth, Herodotus, Plutarch, Dio/ Siculus, Dio Cassius, Bruce's Travels, Browne, Hornam, Ren. Geog., Arrian, Lucan, Q. Curtius, Eutropius, Valer. Maximi, Prideaux, Justin, Josephus, Cicero, and Cæsar.

By the death of Cleopatra, the dynasty of the Ptolemy's was finished after it had lasted about 294 years, and Egypt was converted into a province of Rome. That the people of that country might continue united to the Roman government, none of the noblemen were allowed to have intercourse with the Egyptian people. The kingdom of the Ptolemies was to be subject to a governor; and that office was conferred upon Cornelius Gallus, who was a person of equestrian rank. And, further to restrain the ambitious views of Egypt, it was not allowed to be under the direction of a procurator as the more favoured provinces were; but the government was under a prefect, nor had he the power of life and death, nor the command of public money. His office was continued but for one year, and all the interests of Egypt were jealously watched by the eye of Octavianus.

But all these precautions did not prevent disorders in Egypt. Gallus, the first governor, enriched himself by oppressing the people; and by inscribing his own name and deeds upon the pyramids and other public buildings, he fell under the suspicion of Octavianus; and,
mislead the people, the Emperor collected the books which treated upon that subject, as far as they could be obtained, and shut them up from the inspection of the nation.

But his son Caracalla was less favourable to Egypt. Caracalla. The Alexandrians exposed his follies and vices to ridicule; and he cut off the followers of Aristotle from their usual support in the schools of Alexandria. He executed this purpose professedly from a dislike to the sentiments of that philosopher, but in reality for the purpose of injuring Alexandria. But this disguised method of shewing hostility was soon exchanged for open and avowed violence. His troops rushed into the abodes of the unoffending inhabitants; and, while the whole city was full of terror and dismay, the unworthy emperor viewed the scene from the temple of Serapis, and smiled with savage pleasure. For several successive reigns, the Christians of Egypt were persecuted; and the nation was agitated by competing claims for the government.

Aurelian. A.D. 117.

The Jews fell under the displeasure of the Emperor Caligula, because they refused to receive him as a deity; and, by the orders of Avilius Flaccus, who was then prefect of Egypt, their sacred places were polluted by the images and statues of the emperor; for, to guard against idolatry, there was no painting or similitude permitted to be seen in the Jewish devotions. But, through the influence of Agrippa, the king-elect of Judea, the prefect was removed from Egypt; and banished to Andros. While Claudius was emperor, the Roman conquests were extended into Africa, and the college of Alexandria was improved in splendour; but Egypt was robbed of an obelisk, which was conveyed to Rome, and placed upon Mount Vatican. In the time of the Emperor Nero, the Jews were still persecuted, and on their part they continued turbulent and unwise, insomuch that, in a future reign, their temple at Onias was completely destroyed.

Aurelius.

In the reign of Aurelius, the affairs of Egypt were turbulent and precarious. Some of the discontented, and perhaps oppressed, inhabitants, had taken refuge in the forest of the Delta; and, refusing to pay tribute to Rome, they resisted its power, and destroyed not a few of its servants. Many Greeks, who dwelt in Egypt, joined this resistance, till they were suppressed by Avilius Cassius. This successful leader aspired to the suverainty of Rome, and would have been successful, if his attempt had not been premature. But the report of the Emperor Aurelius being dead, proving to be false, Cassius and his adherents were vanquished, and some of them put to death; yet the memory of Aurelius was extended to Flavius Calvisius, the prefect of Alexandria, who had surrendered the province into the hands of the usurper. Egypt was also visited by the Emperor Severus, who viewed and repaired many of the national monuments. To restrain the spirit of magic which was common in those days, and supposed to

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extremes; and, now that the church had acquired con-
siderable influence in Egypt and with the Pope, a per-
son soon appeared in the see of Alexandria, who abu-
used his power, and degraded his character.

It was Cyril, the bishop of Alexandria, and vicar
of the Roman pontiff, who, by haughtiness and overbear-

conduet, created for himself a host of enemies. In
the exercise of his power, he encroached upon the authori-
ty of the civil magistrate; and Orestes, the prefect of
Egypt, was assailed and abused by the adherents of
Cyril. But there was a darker shade to be added to
the character of the aspiring and violent bishop. Hy-
patia, the daughter of Theon, a celebrated master in
the school of Alexandria, was no less famous for learning
and elegant accomplishments, than she was for beauty
and virtuous qualities; yet she had offended Cyril, and
her life was the forfeit. She was the friend of Orestes
the Roman prefect, and being unjustly accused of cher-
ishing the irritation between him and Cyril, she was
attacked by the multitude in the streets of Alexandria,
and cruelly put to death. But the ambition of Cyril
was as violent in public life as in private, and his in-
temperate dispute with Nestorius, the bishop of Con-
stantinople, remains against him in the annals of the

A. D. 616. - The western empire of Rome having already fallen,
by the intrusion of the Huns and Goths, the Vandals,
and other warlike and uncultivated nations; the eastern
empire, of which Constantinople was the head, was also
fallen into decay, and the Queen of Persia over-ran dif-
f erent parts of the Roman dominions. She likewise
obtained possession of the principal towns and parts of
Egypt. But her triumphs here were of short duration,
and Persia itself was soon added to the dominions of the
Mahomedan conquerors.

Omar.

A. D. 634. - Omar succeeded to the empire of Mahommed, and in
his reign Egypt was subdued by the arms of the caliph.
Amr Benalas marched his troops into Egypt, and, after
much resistance, got possession of Memphis. Mocaw-
cas, the prefect of Egypt, was hostile to the religious
 tenets of Constantinople; and when the Persians were
besieging that capital, he had revolted from his alle-
giance. For these reasons, Mocawcas supported the
interests of the Mahomedan invaders, and, after many
efforts, and various changes of fortune, the city of Alex-
andria surrendered to the Saracens. The town was
exposed to plunder; but at length the people were ad-
mitted into the protection of the conquerors, and if they
did not become Mahomedans, they were to pay a cer-
tain ratio or tribute. Among other disasters which be-
fell Alexandria, its famous library was destroyed; for
the Saracens were then a rude people, and unaclain-
med with the value of letters. And notwithstanding
what has been asserted by the author of the Decline
and Fall of the Roman Empire, the library was not
only destroyed, but learning must have suffered by
that unfortunate event; for it must have contained many
valuable writings of the Alexandrian school.

Amr.

Amr, the conqueror, was also constituted the gover-
nor of Egypt; and having added to its boundaries, he
likewise regulated its internal affairs, and commanded a
channel to be opened between the Nile and the Red Sea.
When Othman was raised to the caliphate, Amr was
removed from the government of Egypt; but his suc-
cessor Abdallah Bensaid was not acceptable to the
people of that province. He renewed the conquest of
Africa, and was successful in his views; but the suc-
cess was owing to the bravery of Zobeir, and not to the
courage or conduct of Abdallah. But being afterwards
unfortunate, he was removed from the government of
Egypt, and Amr restored to his former station. But
this salutary change was not of much avail, and the
improvident conduct of Othman was hurtful to his domi-
nions, as well as fatal to himself. In the subsequent
caliphate, Egypt was involved in the civil wars, which
were occasioned by the competitors for the dominions
of Mahommed; and Egypt was not composed nor set
at peace till Amr was again invested with the govern-
ment of the country, with the most ample and almost
independent powers.

During the contentions which ensued, Egypt threw
off the yoke of the Saracens; but was again reduced to
submission, when Merwan the son of Hakem was raised
to the throne. In the caliphate of Walid, Corrah Ben-
sharik was invested with the government of Egypt;
but he was licentious in his manners, and outraged the
feelings and the decency of the Christian adherents.
But while he was degrading himself by every species
of folly and vice, Mura, the lieutenant of the caliph's
armies, was traversing Africa in triumph, and had re-
ached the fortress of Ceuta, or Pillar of Hercules, on the
African side. Count Julian, the Gothic commander of
this fortress, not only surrendered it to Mura, but of-
fered to the besiegers of Ceuta the protection of his

It was jealousy and resentment among the Gothic
chiefs, which occasioned this offer to the Arabian war-
ior; for Roderick, the usurper but reigning king of
Spain, had many enemies in his dominions, and he had
stirred up the vengeance of Julian, by his infamous
conduct to the daughter of that chief. Musa hesitated,
for he was fearful of a snare; but one of his confiden-
tial generals was willing to make an experiment; and
having sailed from Ceuta, and landed at Calpe, the
other pillar of Hercules, the Saracen army pitched
their first camp where the impregnable works of Gib-
ralta are erected. The expedition was successful, and
Musa being jealous of Tarik or Tarif, his general set sail
for Spain, and completed the conquests which his fore-
runner had begun. If he treated his successful general
with unbecoming severity, Musa, in his turn, was de-
grated by the caliph, and died under the pressure of
infirmities and cares.

These things happened in the beginning of the eighth century, and the Saracens
obtained the chief possessions and management of Spain,
into which they introduced the literature of the East.

For a considerable period of years, the affairs of
Egypt are scarcely mentioned; for the public mind
and the national records were employed with animo-
sity and violence about the succession to the caliphate.
Formerly the family of Ali, the immediate descendants
of Mahommed, had been overpowered, in attempting
to assert their right to the throne; and the house of
Omnia, by power and good fortune, were raised to
the sovereign power. The Omniaes being in their
turn overthrown by the Abbassides or descendants of
Abbas, the uncle of the prophet retired into Spain,

A. D. 786. - Al rashid was a prince of great fame, and he is well
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known as the hero of the Arabian Tales; but in the great variety of his vast engagements, Egypt, as a distant province, attracted little of his attention, though he visited many of his dominions sometimes in disguise, and sometimes openly. The disorders of that country, and other distant possessions, called for his interposition; and he invested Ibrahim, the son of Aglab, with the powers of governor and lieutenant over his dominions in Africa upon the shores of the Mediterranean; and Ibrahim found means to render himself independent. Thus he established the dynasty of the Aglabites, the seat of whose government was at Carthage.

During the reign of Al Rashid, there was nothing remarkable in the state of Egypt, excepting a general feebleness of the government, which happened, as we have already observed, in all the remote provinces; but in the reign of his successor Almansur, the Ommiades of Spain attempted to regain the possession of Egypt. But the caliph of Bagdad invested Abdullah Bertaher with a high commission for repelling the invaders, and restoring Egypt to order. Yet the Ommiades were scarcely dispersed, when the Greeks of Constantinople arrived in Egypt with a numerous fleet. Alarmed by this powerful armament, Ahmed Ben Tholan, a Turkish commander, was sent into Egypt to defend the country, and reduce the inhabitants to order. When he had settled the disturbances in that country, he led a powerful army into the East, and reduced under his own power several cities and provinces of the caliph. His son and successor enlarged his dominions from the falling empire of the caliph of Bagdad, until he returned to Egypt in possession of dominions which extended from the south of the Danubian to the confines of Nubia. But the power of the Tholomides was not of long duration, and Egypt again was added to the empire of Bagdad.

The Fatimites.

The Aglabites, in Africa, ceased to reign, and a dynasty succeeded, whose princes were denominated Fatimites; because they professed themselves the descendants of Fatima, the wife of Ali, and daughter of the prophet. This new race of princes aspired to the dominions which the Aglabites possessed in Egypt; but the caliph of Bagdad defended his Egyptian possessions, and put the Fatimites to flight. At this period, Ikshid, the governor of Egypt, laid claim to the title of independent prince; for the feeble and distracted caliph of Bagdad was not able to restrain his pretensions; and the government of Egypt continued for a while under the Ikshidites. Upon the death of the conqueror who gave name to this dynasty, Egypt was governed in succession by his two sons, who were both under age; but the kingdom was under the regency of Cafur, an old and faithful servant. Upon the death of both the young princes, Cafur was himself seated upon the throne; but his reign was of short duration, for he soon paid the debt of nature.

A.D. 969.

The Fatimite caliph, who reigned in Africa, never ceased to harass Egypt, and got full possession of the kingdom, now that the Ikshidite dynasty was ended. Moez Lediniblah transferred his government from Cairo to Carawan; now Cyrene, in Barbary, to a city which his victorious general Jawhar had built in Egypt. This city was called Cahara, or the City of Mars, and is now the Grand Cairo of Egypt. Though former princes had reigned with professions of independence on the banks of the Nile, yet still the caliph of Bagdad, in the capacity of Imam, or chief priest of the Mahometans, had been mentioned in the mosques and prayers of Egypt; but the new caliph of the Fatimite race interdicted this mark of honour, and claimed for himself the legitimate succession to all the honours of Mahommed. An intricate series of claims and disputes took place between the caliphs of Bagdad and Egypt; and if the former had not been far in the decline of power, the latter must inevitably have been overthrown.

But Hakem Bamritlah maintained his authority in Bamritlah, Egypt, and delivered himself from the power and threatenings of the caliph of Bagdad; nevertheless, he did not continue in honour, for the agitation and difficult circumstances of his kingdom seemed to have affected his mind. The incoherency of his conduct appeared in various instances, and at length he claimed divine honours. It is supposed that he was led into this folly, in imitation of Darar, an extravagant fanatic, who was put to death. But his followers were not extinct; and the caliph, running counter to every Mahommedan practice and institution, the fasts, festivals, and pilgrimages, were forbidden; and when it was apprehended, that even the worship of God would have been set aside, Hakem was assassinated, and the former order of things restored.

Hakem's son, Daher, succeeded to the caliphate, in whose reign nothing important happened; but in the following caliphate, there was a multitude of occurrences, which deeply affected the interests both of Bagdad and Egypt. No sooner had the son of Daher ascended the throne, than he assumed the name of Mostanser Billah, and his cares were directed toward his possessions in the East. But the principal anxieties of his government, proceeded from the feebleness and disorders of Bagdad. The Turks, who had lately assemled by fortune, his Syrian provinces, had also encroached considerably on his power; and Nassir, one of those slaves who had risen to power in the government of Bagdad, having met with opposition in some of his extravagant claims, fled into Egypt, to receive the assistance of Mostanser. This application was attended with success; for the caliph of Egypt entertained a hope that he might seize upon Bagdad, and overthrow his rival caliph.

Nassir having conducted his victorious troops to the very gates of Bagdad, the caliph Alcayem solicited and obtained the assistance of Togral Bey, a Turkish warrior and chief of the Seljuicides. In the mean time, Nassir entered Bagdad, proclaimed the caliph of Egypt sovereign of the city, and treated with great severity the emir Almor, as well as other persons of distinction. But Togral Bey approached the city, restored the caliph, and Nassir was put to death. Thus were the hopes of Mostanser Billah not only frustrated with respect to Bagdad, but, upon his reverse of fortune, his Syrian provinces revolted, and he was dispossessed of every foreign possession. To his foreign disappointments, famine and pestilence were added; and the whole was followed by an invasion of Egypt by Naseraloulah, a Turkish general, who had taken refuge and found protection at the court of Cairo. The caliph was unexpectedly besieged in his palace, and, being altogether unprepared for such an attack, he was compelled to purchase his safety at an extravagant price. After seeing himself disgraced, and his country plundered, he was relieved from his afflictions, and closed his eyes from the sorrow of his kingdom.

Abuleassem, surnamed Almostali Billah, was seated on the Egyptian throne. But the affairs of Egypt embra- a.D. 1096 ced at this time little more than domestic quarrels, with some feeble excursions into Syria and Palestine. Caliph succeeded caliph in common succession; but
every new sovereign had his power diminished, till the vizier, or prime minister, was in every thing caliph excepting in name. During the reign, if it might so be called, of Hafedah Ledinillah, the grandson of Mostanser, his vizier Redwan was saluted at Grand Cairo by the title of king. His presumption, indeed, in procuring this appellation from a party of his supporters, was followed by dislike and violence, and he was driven from the country; and finally put to death. Amid these internal commotions, the caliphs themselves were sometimes put to death; but still the viziers increased in power.

At length the appellation of vizier was not sufficiently dignified for the prime minister of the Egyptian caliph, and therefore they now assumed the name of sultan; and the dynasty of the Fatimites was drawing to a close. In 1164, Shawer, a person of consideration, was raised to the confidence of Aladil, the caliph of Egypt; but a competition for power having arisen between him and Aldargam, they had recourse to arms, and Shawer being defeated, took refuge with Nureddin, the prince of Syria, and solicited his assistance. The prince of Syria sent an army into Egypt under the command of Asoddudin, and Aldargam was soon overthrown. But Shawer being reinstated in power, neglected to fulfill his engagements with Nureddin, which occasioned several mutual attacks. In the mean time, the armies of the crusade had laid siege to Grand Cairo; and the caliph, with his whole court, being in danger, Nureddin was invited to give them assistance, which he readily consented to do; but, before his arrival, the siege was raised by the influence of bribes and high promises. When Asoddudin, the general of the Syrian prince, arrived at Grand Cairo, he was received with demonstrations of joy; but Shawer, conscious of his own faithlessness, and fearing the displeasure of Nureddin's general, formed a scheme of putting him to death. But the plot was discovered, and Shawer himself beheaded. Asoddudin was made vizier in his stead; but having died in the course of a few weeks, he was succeeded in office by his nephew Saladin, whose fame became great in the annals of the East.

The new vizier kept up a show of submission to the prince of Syria, though he did not intend to continue in a subordinate condition. In the mean time, Nureddin ordered Saladin to omit the name of the caliph Aladil-Sedinillah in the public prayers, and to substitute the name of the caliph of Bagdad. But when the order arrived, the Egyptian prince was breathing his last, and insensible of the disgrace. In the person of this caliph, the dynasty of the Fatimites was ended.

Upon the death of Aladil, the caliph of Egypt, Saladin, being in possession of the chief power in his character of vizier, seized upon all the wealth of the late prince, which was various and valuable. He threw his whole family into confinement, and adopted every measure which his wisdom could devise, for establishing in his own person the supreme authority of the state. He maintained a show of obedience to Nureddin, the prince of Damascus, but was secretly determined to acquire an independent rule in Egypt. This intention, though disguised, could not be concealed from the powerful and declining Nureddin; and, while he seemed satisfied with the conduct of Saladin, he was raising a numerous army to resist and overthrow his power; but in the mean time, he was seized with a sudden illness, and died at Damascus.

But the death of this prince did not deliver Saladin from danger; for Nureddin's successor was both able and willing to give him just cause of alarm. In these circumstances, Saladin wished to secure a retreat, and for this purpose he sent his brother Malec Turunsheh into the kingdom of Nubia; but finding it desolate and barren, he returned to Grand Cairo, and thence he was dispatched with a numerous army into Arabia Felix. There he was successful, and reduced a considerable part of that country under the subjection of the Egyptian vizier. Saladin having enlarged his dominions, and confiding in the means which he had devised for becoming master of Egypt, was determined to assume a name suitable to his views. Not being a descendant of Mahommed, he could not be denominated caliph, which implied the sacerdotal as well as the kingly office. On this account he chose the name of sultan, and left the office of pontiff, who had the charge of religious affairs, to be filled up by a descendant of the prophet.

Though Saladin was acknowledged as the sultan of Egypt by many of the neighbouring states, and even received the sanction of the caliph of Bagdad, which gave him a name and influence among the followers of Mahommed, yet he was not secure from intestine commotions. The friends and adherents of the Fatimite caliphs raised a rebellion in the kingdom, and a pretender to the throne collected an army of 100,000 men. These, however, were soon defeated by the power and address of Saladin; but no sooner was he freed from this alarm, than he was threatened by the soldiers of the crusades. William II. king of Sicily, had engaged in the Christian wars, and laid siege to Alexandria both by sea and land: But the enterprising spirit of Saladin frustrated his views. With a rapidity of movement which was peculiar to the energetic mind of the Egyptian sultan, he marched to the relief of Alexandria; and the crusaders, with a sudden panic, fled from the siege, leaving their stores, baggage, and engines.

At this time the government of Damascus was under a regency; for Malec Alasleh was under age, and the government of affairs in his minority was not acceptable to the people. Amidst these discontents, Saladin was requested to accept the sovereign power of Syria. Having arrived at Damascus, he found little difficulty in becoming master of the country; but he professed to assume the government in the name and for the interest of the young prince. Having settled the affairs of Damascus, he marched with a successful army through various parts of the country, while his growing prosperity excited suspicions; and the ministers of Malec, the prince of Damascus, entering into a combination with some of the neighbouring powers, sought an opportunity to check the career and disappoint the designs of Saladin. A battle ensued; but the Syrian forces, together with all their allies, were defeated, and the sultan of Egypt was left master of Syria.

Saladin returned from his eastern conquests, and began to aggrandize and fortify the city of Grand Cairo. He encouraged the schools and literature of the country; but was drawn away from the pursuits of elegance and domestic improvements, to the din of arms and the ravages of war. Having obtained possession of Syria, he was anxious to acquire Palestine; and therefore he led a numerous host against the armies of the crusade, who had assembled for the defence of the Holy Land. But there he met with the most obstinate resistance; multitudes of his army perished in the field of battle; and when he was forced to return towards Egypt, a still greater number died in the desert, from hunger, thirst,
and disease: yet still the views of Saladin were toward Syria and the East. At the commencement of this campaign, his army was defeated both at Aleppo and Mossul; and, in the mean time, the Christians of the crusade had assembled a fleet in the Red Sea, which threatened the cities of Mecca and Medina; but Abubeker, Saladin’s viceroy in Egypt, fitted out a fleet under the command of the brave and experienced Lulu, which opposed the European expedition, and gave fresh vigour to the exertions of Saladin. In the spirit of conquest, he entered the provinces of the East; and to trace his progress, would be to follow him like lightning from field to siege, and from siege to battle.

Having run a triumphant course through Syria, he entered Palestine with victory and terror. Having obtained possession of Aleppo and Mossul, he aimed a blow at the Holy Land. For the space of three years, Saladin continued to gain advantages over the armies of the crusade. Various places of strength having fallen, Tiberias was at length taken, and Lusignan, king of Jerusalem, was desirous of meeting Saladin in the field. The armies met upon the banks of the Jordan, and victory was declared in favour of Saladin. The king himself was taken prisoner, as well as Arnold, lord of Carac. The king of Jerusalem was treated with respect, but Arnold was put to death by Saladin’s own hand, because he had inflicted many miseries on the followers of Mahommed. Ptolemais, Neapolis, Caesarea, and other cities, fell into the power of Saladin. Finding nothing to oppose his course, he marched directly toward Jerusalem, and besieged the city. The garrison was numerous, and made a desperate defence; but after Saladin had made a breach in the walls, and was on the point of entering the town, the commander made offers of capitulation.

But Saladin refused to accept of the terms, and vowed that he would sack and destroy the city. His cruel threatenings roused the spirit of the Christians, and a herald declared, that they would first put 5000 mussulman prisoners to death; and, that no European might be exposed to their revenge, they would also destroy their wives and children. That no booty might be found, they would destroy everything valuable in the city; and, having levelled the rock which the Mahomedans held sacred, they would sail out in a body upon the besiegers; and if they were not victorious, their destruction should be accomplished by an unexampled experience of blood and misery. This desperate resolution moved Saladin to more reasonable terms; and the garrison, as well as the citizens, were spared by paying a stipulated sum of money.

In this embattled state of the Christian armies, a third crusade was determined on in Europe; and the emperor of Germany, together with Philip II. of France, and Richard I. of England, having arrived in Palestine, encamped before the city of Acca or Ptolemais, whilst many European ships rode in the harbour. In this city, Saladin had assembled a numerous army; and the powers of Europe were combined to defeat him. Richard I. of England was of great courage, and therefore was surnamed Cœur de Lion; and his skill in war, added to his prowess, had rendered him the most famous general of the age. If there had been as much harmony as there was power among the different armies of the crusade, the city of Ptolemais must soon have fallen; but, after all the distractions in the views and counsels of the allies, Saladin was compelled to capitulate. The garrison were allowed to march out with the honours of war; but a sum of money was to be paid to the besiegers.

The sultan of Egypt refused to pay the ransom; and historians tell us, that 5000 prisoners answered for it with their lives. The siege was extremely bloody; and it is not supposed that fewer than 300,000 persons on either side were cut off during the conflict; and the flower of Europe, as well as Egypt, Asia, and Syria, perished in the combats. Ptolemais, or Acca, became the residence of the hospitalers of St John, and, since that period, the town has been denominated St John d’Acre.

Of all the European potencies, the king of England only remained; and, having laid siege to Ashkelon, he took possession of that city. Upon this event, Saladin hastened to Jerusalem; and Richard followed him to the holy city. The king of England held it in close siege; but when the hour arrived that the city was to be delivered up, the besieging army retreated, and the enterprise was abandoned. The cause of this sudden and extraordinary conduct has never been well explained; and different authors have presented different views of the subject. It may justly be supposed to have been involuntary on the part of Richard; for his courage has never been questioned; and the value which he set upon his honour could not permit him to tarnish it by unworthiness of conduct. The retreat of the army, it is said, overwhelmed him with grief; and his misfortune was increased by the discord and jealousies of the combined army. The Duke of Burgundy, who was left in Palestine by the king of France with 10,000 soldiers, is said to have been as jealous as his master of the fame and valor of the English king; but, even in his retreat, Richard was formidable. He concluded a truce with Saladin for three years and upwards; various places of strength were dismantled; the whole sea-coast from Jaffa to Tyre was surrendered to the Christians; and the pilgrims of Europe, travelling to Jerusalem, were to be under the protection of the powerful Saladin. But scarcely had the king of England returned to his country, when the health of Saladin began to decline; and he finished his life about the 55th year of his age, and after he had reigned in Egypt 24 years. See Abulpharag, D’Herbelot, Rinaldi, Will. Tyr. Vertot, Sa- nut, Jac. de Vitriaco, and Dr Wilson’s Hist.

Alaziz, the second son of Saladin, was appointed to the government of Egypt; but, not being contented with the portion of his father’s dominions assigned to him, he made successful inroads into Syria; but died suddenly in the midst of his triumphs. Upon his death, several important changes took place with respect to the affairs of Egypt and Syria; but nothing worthy of notice till the reign of Alcameal.

When this prince was raised to the throne, he was well received by the Egyptians; but he found the state of public affairs full of disorder, and attended with danger. The Mahomedans and the Christians were plotting each other’s destruction; and the Christians were at variance among themselves. In this state of internal disquietude, the soldiers of the fifth crusade landed in Egypt, and laid siege to Damietta. The united forces of Egypt and Damascus could not overcome the European army; but Alcameal offered such terms of accommodation as were acceptable to all the chiefs of the crusade, except D’Albano, the Pope’s legate.

Such influence had the see of Rome then acquired, that his single voice prevented the negotiation. The
The siege was continued, and the town of Damietta fell. Elated with this success, they pushed into the interior of the country; but were vanquished by the Egyptians, and were compelled to sue for mercy. The sultan of Egypt became powerful in Syria, as well as at home; and, when Frederick II. of Germany found it necessary to return to Europe, he entered into a league with Alcameh, which was wise and profitable for both.

Alamel died at Damascus, and Aladel, one of his sons, was raised to the throne; but Nojmoddin, his eldest brother, laid claim to the kingdom. A bloody contest would probably have ensued; but, in the meantime, Aladel died or disappeared; and his brother Nojmoddin was peacefully proclaimed sultan. He, too, acquired influence with the most powerful party of the crusades; for Richard, the earl of Cornwall, perceiving that the sultan of Egypt was more powerful than the Syrian lords of Carac and Damascus, entered into an alliance with Nojmoddin, and renewed the treaty which Frederick of Germany had made with Alcameh his predecessor. By this covenant, the Christians were protected, and the views of Nojmoddin encouraged, in opposition to his Syrian rivals.

In this settled state of affairs, Nojmoddin passed into Syria, and, with the help of some uncultivated tribes, determined to overpower his eastern enemies. That part of the crusading armies which was favourable to the lords of Syria, joined them in opposing the sultan of Egypt; but Nojmoddin overthrew them with great slaughter. In the mean time, a host of warriors from Europe arrived in the port of Damietta, with Louis IX. of France as their leader. In the absence of the sultan, and when the nation was unprepared for this unexpected attack, the armies of the crusade entered Damietta. The news of this event were quickly carried into Syria; and Nojmoddin having raised the siege of Damascus, hastened to Egypt to protect his kingdom, but he died by the way, and left a vacancy in the government when a vigorous administration was particularly wanted.

The country received a seasonable relief by the address of Shajir Aldor, the favourite female of the late sultan. Pretending that Nojmoddin was indisposed on his journey, the principal lords of the country were induced to swear allegiance to his only son Turan Shaw. The veil was then taken off, and the young prince was proclaimed sultan, upon his arrival from Damascus with a numerous army.

The European soldiers had by this time penetrated far into the country; but they paid dearly for their rashness; and Louis himself was taken prisoner. Turan Shaw had the name of Sultan, but none of its powers; for Shajir Aldor, and her adherents about the court, directed in reality the affairs of state. The young sultan was sensible of his situation, and determined to assert his proper rights. Being strictly watched, Shajir Aldor was aware of his intention, and he was violently put to death.

The young prince having been assassinated, Shajir Aldor was declared to be sovereign of the country. She was prayed for in the mosques, and her name was impressed on the coins. This active and designing woman was raised to the throne by the power and influence of the Mamelukes. These were a body of Turkish slaves, who had gradually acquired authority at the Egyptian court. When Saladin usurped the sovereignty of Egypt, he durst not entrust himself to the national troops, but placed about his throne a powerful body-guard of slaves from Kipza, whom the Moguls acquired in war, and sold into bondage. Successive sultans increased the power of these attendants by new privileges; and, upon the death of Nojmoddin, they had in reality the disposal of the sovereign power.

Ibeg, one of the Mamelukes, who, from their power in the state, were called emirs, was chosen to be the prime minister, or rather regent of the kingdom. But still the people were dissatisfied with the government of a woman, and the management of a foreigner. In this situation of affairs, Shajir Aldor was deposed; and Musa, a descendant of Alemel, elevated to the throne. But his reign was short as well as turbulent; and, in the midst of internal commotions, the young sultan was removed from the throne; and, with his government, the reign of the Ayubites was terminated.

Ibeg, who had reigned with Shajir Aldor, was proclaimed sultan by the Balarite Mamelukes, and he immediately espoused Shajir Aldor; but, through jealousy, and an idea of ingratitude, she hired assassins, and Ibeg was put to death. By a party of the Mamelukes, Nurededdin Ali was raised to the throne of his father Ibeg, by the surname of Almansur; and Shajir Aldor was put to death. About this time, the Moguls had overrun all the Saracen possessions in the East, except Yemen and Egypt; and the power of the caliph was almost at an end in Bagdad. It was in this perilous conjunction of affairs that the young sultan began his reign in Egypt; and in that situation he was overthrown and deposed by Cutuz, an artful and ambitious chief.

This warlike prince entered Syria with triumph; and, for a time, was formidable to his enemies: but Bibars, one of his generals, acquiring influence with the Mamelukes, deposed Cutuz, and was proclaimed sultan in his stead. It was pretended that the merits of Bibars had been neglected; but, in truth, the reason is to be discovered in the power of the Mamelukes, and the feeble state of the government. For, as the army, in the decline of the Roman empire, created emperors at their pleasure, so did the Mamelukes of Egypt, at this period of its history, raise whom they would to the office of sultan. To give his usurpation a more legitimate colouring, Bibars acknowledged the pretensions of Ahmed, the professed son of Dalber Billa, a caliph of Bagdad; and he was acknowledged as imam, or pontiff of the Mahomedans in Egypt. Bibars received the benediction of this Mahomedan pontiff; and by that means acquired greater influence among the people. In truth, he was a successful warrior, as well as a benefactor to the dominions which he acquired; and, at the time of his death, his empire extended from the interior of Africa to the river Euphrates.

From this time till the year 1293, there were rapid changes among the sultans of Egypt; but though the government was unstable, yet the nation was powerful; for the Mamelukes were brave and warlike. When Naser Mahomed was proclaimed sultan, he was only in the 9th year of his age, and suffered various reverses of fortune. Thrice he had abandoned the throne of Egypt; twice by compulsion, and once by choice. But in the progress of events, being firmly established in power, he exercised his authority, as well as his active mind, to correct the abuses of the state, and restrain the exorbitant influence of the emirs and lords of the court. He improved the fertile fields of the Delta; threw streams of water into the city of Aleppo, and repaired the canal as well as the reservoirs of Alexandria.

Upon the death of Naser, Abubeker his son succeeded.
Egypt.

ed to the throne; but so rapid were the changes of royal succession, that twelve descendants of Naser Mahommed successively extended their reign through the period of forty-one years. During the short and turbulent reigns between Bibars and Naser Mahommed, and while the Sultan Calib was on the throne of Egypt, the city of St John d'Acre was taken from the Christians. The attack was violent, and the defence brave; but the Mussulmans obtained possession of Acre, and the whole land of Palestine, after much treasure had been spent, and innumerable lives lost in the wars and victories of the crusades. Soon afterwards, the knights templars departed into Europe; but those of St John formed a settlement in the island of Rhodes. From this situation they made frequent inroads into Egypt; for, although the knights were comparatively weak, yet the distracted situation of Egypt permitted them to retire from the coast, without the severe vengeance which they might have inflicted; but indeed Egypt was in the utmost state of distraction; and a revolution in the government could not be avoided. If the Ayubite dynasty was superseded by the Baharite, the Baharites, who surrounded their throne, the Baharite sultans were also supplanted by the Circassian slaves, who had been cherished at court, and permitted to acquire uncontrollable power. The sultan Hagi, who was but a child, was deposed by the influence of a Circassian chief; and the Baharite dynasty was terminated in Egypt, after it had existed about 128 years. See Abulfarag, Deyvignes, Olivier Scholast. in gest. Dei francois D'Hericleot; and Dr Wilson's Hist.

The Circassian slaves, whose chiefs had in their turn become masters of Egypt, were called Borgites, because, in the capacity of soldiers, they had been dispersed through the different fortresses of the country, to keep in check the people, who had long been in want of subordination; and these fortresses were called Borges. Barcok was the first of this dynasty on the throne of Egypt; but so powerful were the adherents of the deformed family, that Hagi was soon restored to the kingdom. But his renewed power was of short duration, for Barcok suddenly recovered his situation, and the Borgite dynasty was established. Scarcely had he overcome the internal enemies of his kingdom, when he was threatened by a formidable power from without. Tamerlane the Great, who had formed the new empire of the Moguls, and denominated the Cham of Tartary, was desirous of adding Syria to his dominions; and the sultan of Egypt marched with an army to meet him at Damascus. At the approach of Barcok, Tamerlane retired; and, directing his course towards India, his arms were attended with great success.

In the mean time, Bajazet, at the head of the Ottoman armies, and the rival of Tamerlane, was spreading terror upon both sides of the Hellespont, and had carried his arms to the very gates of Constantinople. Indeed, he was determined to take possession of that city, and establish his government upon the ruins of the Roman empire. For this reason, he solicited the friendship of the Egyptian sultan, and the blessing of the caliph, who was then residing at Grand Cairo without any civil authority, but only as imam of the Mahomedan faith.

About this time, Barcok died; and his son Pharage, surnamed Abulsaadat, reigned in his stead. When this prince obtained the government, he was but ten years of age; and the affairs of the kingdom were managed by a regent. In these circumstances, the national commotions were continued; and his Syrian dominions rose in rebellion. But Abulsaadat, under the influence of his native vigour, took the reins of government in his own hand, recovered the provinces which had rebelled, and put his whole kingdom into a state of order and obedience. In this situation of affairs, Tamerlane returned from India, and found that his rival had been extending his power, and was more formidable than ever.

These ambitious and terrible warriors were determined on each other's destruction. Bajazet laid claim to the assistance of Egypt, because he had entered into a formal alliance with the sultan; but he did not receive the expected support, because he had not been faithful to the terms of agreement; and we may add, that the power of Tamerlane was another reason with the sultan of Egypt, for withholding aid from his rival Bajazet. These two powerful chiefs met once and again in the field of battle, when Bajazet was finally overthrown, and taken prisoner. Having overcome his rival, the ambition of Tamerlane was more unbounded than ever. He intended to ravage the south of Europe across the straits of Gibraltar, and continue his course through Egypt and Syria, till he arrived at the seat of his government in the East. But there was one power of which he stood in awe, and which prevented the project which his ambition had laid. The knights of St John, now established at Rhodes, and enriched by the spoils of the forfeited Templars, were formidable to the neighbouring powers, and maintained a mighty preponderance in the scale of nations. Though small in numbers, their strength was great, their fame extensive, and their courage well tried.

In these circumstances, it was not expedient to attack the knights directly in the island of Rhodes; but he laid siege to Smyrna, and reduced it to ashes. He was drawn away, however, from any further attempts upon the power and interests of that religious order, by dangers which were threatening him in the East. A powerful prince, whom Tamerlane had subdued in his Indian expedition, appeared again with renewed strength, and was laying waste the kingdom of Persia. Thither he directed his course, but his power was much diminished through a long succession of obstinate engagements; and, having met his enemy in greater power than was expected, they entered into terms with mutual agreement; and Tamerlane, having withdrawn from public life, retired to Samarchand, and there, in a few years, ended an active and victorious life. In the mean time, the distractions of Egypt still continued; and the sultan Pharage Abulsaadat, being weary with continual broils and confusion, retired from the dangers of public life, and surrendered the throne to his brother Abdolaziz, but to assume it again.

This happened in the year 1405; and there was little more than a rapid succession of feeble monarchs, till the year 1517, when the Borgite dynasty was overthrown; and the kingdom of Egypt was converted into a province of the Turkish empire. During this period, there were many broils, and much warfare between the sultans of Egypt and the kings of Ithrones. The Portuguese, who had acquired some settlements in India, alarmed the governors of Egypt, who had long been enriched by the merchandise of the East; and ineffectual efforts were made to overthrow the power of the European invaders. In the mean time, Europe itself was in commotion; and, upon the 29th of May 1453, Constantinople was taken by Mahomed II; the sultan of the Turks. This success opened his way.
to the kingdom of Egypt; and Tuman Bey, the last of the Circassian or Borgia dynasty, was basely put to death at Tavifs, one of the gates of Grand Cairo.

The race of princes who were now seated upon the throne of Constantinople, and had added Egypt to their dominions, derived their origin from the Scythian or Tartar tribes, and were afterwards denominated Turks, from the word in their own language which denotes a helmet. Selim, though a younger son, got possession of the Turkish government, by deposing his father, and putting to death his elder brothers. The same ambition which impelled him to deeds so cruel and unnatural, induced him, in a way more honourable for a warrior, to establish his power, and extend his empire. He successfully invaded the kingdom of Persia, engaged the Egyptian forces at Aleppo, and, after various successful efforts, carried his victorious course to the banks of the Nile, and easily became master of the country, which had long been agitated by internal commotions, and was then in a revolutionary state.

He continued for a considerable time in Egypt, and settled the form of government, after the manner which had been adopted by the Turkish sultans. He converted with him to Constantinople the caliph, or spiritual head of the Mahometan religion. Upon his death, another was appointed in his stead; but at his demise, the order of caliphs terminated, and a mutiny was substituted, who had the supreme direction of the Moslem faith; while the ulema, or chosen body of men, are invested with the power of interpreting the Koran. Imams, or persons subordinate to the mutfi, are sent into the different provinces, and four of them were appointed to Egypt. In the early times of the Turkish or Ottoman government, there were only two Beys, who, in the capacity of chief governors, presided over the dominions of the Turks. One of them had the command of the European provinces, and the other was entrusted with the command of Asia Minor. As the Ottoman empire was extended, the number of the Beys were increased; and each of those in chief command was called Beyler-bey, or Prince of Princes. At first there was a Pasha of Egypt, with sixteen Sanjaks under his authority; but in process of time, the Sanjaks were exchanged for twenty-four Mamelukes, who also assumed the name of Bey, or princes, to whom the government of the various provinces was entrusted.

In the most perfect form of the Turkish government in Egypt, it consisted of a divan, or council of regency, composed of those who commanded the military bodies, and whose president was the Pasha or viceroy. From the Mameluke beys, who commanded the provinces, were chosen the Sheik al Belled, or governor of Grand Cairo; the Janizary Ağa, or commander of the Janizaries; the Defterdar, or accountant-general; the Emir al Haga, or conductor of the caravans; the Emir al Said, or governor of Upper Egypt; and the Sheik al Bikkeri, or director of the sheriffs. In subordination to these, there were cashiphs, or deputies, and other officers of inferior note.

Soliman I. succeeded his father Selim; and he not only began his reign by crushing rebellion in the provinces, and adding dominions to his empire, but his name was terrible among the nations. He was the competitor of Charles V. and overthrew the power of the knights in the island of Lliodes. But even in his time the factions in Egypt were not at rest; and in the more feeble reigns of his successors upon the throne, the Ottoman power in that country was much impaired, and the form of government at last changed. The beys, who superintended the 24 departments in Egypt, collected the revenues of their respective districts; and by that means acquired an influence which was not intended. The heads of the seven military corps and the pasha became avaricious, and courted the favour of the beys, who could enforce the payment of tribute with severity, or remit it in part, according to their pleasure.

By indulging the members of the regency, the beys increased in power till they obtained the complete disposal of public affairs. Every bey had originally a few Mamelukes or slaves at his command, for enabling him to make his authority respected in the province where he resided; but as the power of the beys was enlarged, they increased their attendants, and in proportion to their number of slaves, so was their strength. When a vacancy occurred in the government of the provinces, the most powerful bey had his favourite Mameluke appointed to the office: this election increased his authority; and, by pursuing a similar course, the most active and powerful beys acquired a continually increasing influence in the government, and their Mamelukes became the only efficient soldiers in the state.

The members of the divan having become subservient to the pleasure of the beys, the beys got possession of every important office, with the exception of the vice-regal appointment. But in their career of devastation, the pasha of Egypt also became subject to the Mameluke beys. The Sheik Albelled, or governor of Grand Cairo, was chosen from amongst the beys, but he was approved or rejected by the pasha. The Sheik Albelled was the constitutional organ through which complaints were made to the Grand Signior, when the pasha violated the rights of the community; but to remove him from his office could only be done by the sultan himself. But in process of time, when the divan fell under the control of the beys, they dismissed them at pleasure; and when a new one was appointed, if they discovered by their spies, that he was entrusted with any mandate inconsistent with their views or authority, they never suffered him to approach Grand Cairo, but intimidated at Constantinople, that another pasha must be chosen.

In these circumstances of the Egyptian government, an active youth among the slaves who were brought from the neighbourhood of Mount Caucasus, grew up to great influence and fame in the house of his master (Bismah), who was a boy of the Janizaries, like other Mamelukes, this young slave became a Musulman, and received the name of Ali. Having gone through different offices in the house and service of his master, he was raised to the office and rank of a bey. Upon the death of Ibrahim, to whom he owed his power and elevation, considerable commotions existed; and in the year 1763, Ali Bey obtained the office of Sheik Albelled, by which he was invested with the chief authority of the state.

In the struggle for power, Ali Bey was more than once obliged to flee from Egypt, and seek refuge in Palestine or Syria. He became obnoxious to the Turkish Divan, and the Grand Signior sought his destruction. But in the year 1768, the court of Constantinople proclaimed war against the Emperor of Russia; and while the Ottomans were employed in defending their provinces against the northern invasions, Ali Bey was not only active in reducing Egypt to obedience; but he sent an army into Arabia Felix, for purposes of conquest and aggrandisement. The troops of Ali, under the conduct of Mahommed Bey, were successful against the Turkish garrisons; and they took possession of Gaza, Tatta,
and Shechem, or Naples. They even reached Jerusalem, and having arrived at St John d’Acre, they formed a junction with the troops of the celebrated Sheik Daher. The forces of Ali entered Damascus. But after tarrying a few days, his general Mahommed hastened to Grand Cairo, and compelled his master Ali Bey to take refuge in Palestine, where his arms were attended with success, being supported by the Sheik Daher.

Osman had been constituted Pasha of Damascus, and invested with extraordinary powers by the divan of Constantinople, that he might oppose and subdue the Sheik of Acre. Ali Bey and the Sheik Daher fearing equally hostile to the Ottoman power, entered into a treaty to support each other in their views and pursuits. The Egyptian Bey had attempted to secure the assistance of Russia, by negotiating with Count Alexis Orlov, the commander in chief of the Russian forces in the Archipelago; but the negotiations had been attended with little success, until a Russian transport, under British colours, commanded by Captain Brown, appeared off Jaffa, and assisted the forces of Daher and Ali Bey to get possession of that town and fort. By these and other means, Daher obtained considerable power.

But though the Sheik Daher and Ali Bey had been so far cordial in their co-operations, yet their interests might soon interfere, and their friendship be dissolved. This might be a sufficient reason of itself for Ali Bey to go in quest of possessions which were likely to be more permanent; and both his interest and inclination led him towards Egypt, where he had once been in power. But his former general, and now competitor, Mahommed Bey, was still in great power, and met him with a numerous army, in the desert which lies between Gaza and Egypt. The armies engaged, and Ali Bey, being wounded, was taken prisoner. His rival Mahommed seemed to receive him with great respect. For at the first interview, even in his fallen state, his former authority might have some remaining impressions, even upon the mind of the revolted general; but upon the third day the unfortunate Ali died, and not without suspicions that his death was occasioned by undue means.

By the death of this powerful chief, Mahommed Bey was left without a rival in the kingdom of Egypt; but in the fluctuating state of public affairs, he was aware that competitors might soon arise, and he was well assured that the divan of Constantinople would endeavour to recover their power in Egypt, as soon as they could withdraw their forces from the wars in which they were engaged with the Emperor of Russia. For some time past, no Pasha had been admitted in Egypt from the court of Constantinople, nor any tribute remitted to the Grand Signior. But Mahommed Bey, though hostile to the power of Constantinople, made extraordinary professions of friendship, and transmitted to the Grand Signior a large sum of money. Both parties dissembled; the reigning Bey of Egypt intended to manifest his independence as soon as circumstances would allow, and the court of Constantinople were determined to take the first opportunity of reducing Egypt to obedience; but in the mean time, they made a show of attachment to Mahommed, and raised him from the office of Sheik Albeled to that of Pasha, or viceroy of the Sublime Porte.

To ingratiate himself still more at the court of Constantinople, he marched an army into the East, under the pretext of subduing the Sheik Daher, who was inimical to the Ottoman authority, but in reality to obtain such conquests in the East, as would render him formidable to the power of the Grand Signior. Having gone in person to Syria, his army was attended with success; but he was seized with a fever, and died on the second day of the disease.

When Mahommed’s death was announced in Egypt, A. D. 1776, the country was in commotion, but the principal competitors for power were the boys Ibrahim and Murad. After various attempts to obtain the ascendency, it was at length agreed that the powers of the state should be held in common by the two contending chiefs. Ibrahim was to continue in the office of Sheik Albeled, and Murad was raised to the situation of Defterdar, or accountant-general. About this time, peace was concluded between the courts of St Petersburg and Constantinople, and, as might have been expected, the Grand Signior was determined to restore his power in the province of Egypt.

By the active and prudent services of Prince Potemkin, the Empress of Russia had obtained from the Grand Signior a vast extent of territory, which included the Crimea, together with the provinces of Circassia, Georgia, and other districts. The fleets of St Petersburgh were permitted by treaty to traverse the Black Sea; and as all these circumstances weakened the Ottoman government, it was the more necessary to recover Egypt, with its resources and tribute.

A fleet belonging to the Grand Signior arrived at A. D. 1758, Alexandria in the month of May, and landed an army of 25,000 men. The forces of Ibrahim and Murad Bey were drawn out to oppose their progress, and the armies met between Rosetta and Grand Cairo. The dexterity of the Mamelukes, who always fight on horseback, threw the Ottoman army frequently into confusion; but the skill and perseverance of Hassan Pasha, finally triumphed over the irregular though intrepid warfare of the Mamelukes. Ibrahim and Murad Bey withdrew by treaty into Upper Egypt. Hassan returned to Constantinople, and Beker was sent into Egypt with the honourable distinction of a pasha of three tails. Notwithstanding his power, he was but ill received, and found it impossible to collect the tribute, or preserve the country in order. But these irregularities soon gave place to designs and achievements of greater moment. The French directed an expedition against the province of Egypt, which was followed by warlike exertions, both of Great Britain and Constantinople. See Cant. Mign. Revolt of Ali Bey, Brown, Volney, and Life of Potemkin.

After the republican armies of France had vanquished Holland, shaken the power of Austria, overthrown the states of Venice, and trampled upon the independence of Italy, many inferior states sued for protection; and at Campo Formio, upon the 17th of October 1797, a treaty was entered into between the Emperor of Germany, and the Republic of France. By this convention, the Austrian Netherlands, as well as the Venetian islands in the Levant, together with several districts of Italy, were all ceded to the French nation; and although Venice, with several territories of importance, were granted to the Emperor of Germany, yet they did not restore him to his proper rank in the scale of Europe. Elated with these conquests, France had been threatening the independence of Great Britain, and attempted to wound her on the part of Ireland, where many discontented were already brooding.

After the peace of Campo Formio, the public were more than ever amused with the designs of France.
against Great Britain; but while the attention was directed to that quarter, preparations were secretly making at Toulon for a great and important expedition. The fleet was large, and the soldiers of every description amounted to 40,000 men. The command of the fleet was bestowed upon Admiral Brueys, and the command of the army was entrusted to General Bonaparte. The fleet sailed about the end of May; and having landed at Malta, got possession of the island by fear or treachery. Having arranged the affairs of that settlement, the French fleet set sail again upon the 19th of June, and directed their course towards Egypt.

These movements of the French were not unknown to the British government, and Admiral Sir Horatio Nelson was appointed to the command of a squadron to watch the motions of the French fleet. Having looked into the harbour of Toulon, and found they had escaped, he immediately sailed toward Egypt, whether it was supposed they had directed their course. Having learned at Malta that they had departed for Egypt, he crowded sail and stood after the fleet of Brueys. The French admiral steered his course along the northern coast of the Mediterranean Sea, while Nelson kept near the African shore. On this account, he arrived off the coast of Egypt before the French fleet made their appearance; but not finding it expedient to wait upon that station, he steered his course into the Levant. But soon after his departure, the French fleet appeared upon the Libyan shore, a few leagues to the westward of Alexandria. The friends of the Grand Signior, and the Mameluke beys, were equally alarmed at the arrival of the French; for if they got possession of the country, both the one and the other would be divested of their power.

In this situation, no time was to be allowed for the forces of Egypt to be collected in numbers; and, therefore, the landing of the French forces was instantly begun at Marsab. Bonaparte himself led the way; and without waiting till the whole forces were on shore, the troops began to March toward Alexandria on the second of July, between two and three o'clock in the morning. They met with considerable resistance, and the city refused to surrender; but the French army burst into the town, and a dreadful slaughter ensued. Generals Kleber and Menou were wounded, and several French officers of distinction lost their lives. Having reduced Alexandria to obedience and order, Bonaparte directed his troops to march for Grand Cairo; while, at the same time, he ordered a flotilla to sail up the Nile and meet the army at Ramannah. In the meanwhile, Admiral Brueys moored his fleet on the coast of Aboukir, with the view, if possible, to have them afterwards removed to the old port of Alexandria, which is the safest harbour in Egypt.

The troops under general Desaix marched across the desert, and other divisions followed the same route. They suffered much from hunger and thirst, as well as from fatigue, and arrived upon the 19th of July at Ameldinar, near the upper point of the Delta. By this time there had been a general rendezvous of the French troops; and having seen the beys appearing in force, they resolved to give them battle. The Mamelukes retired, but in the afternoon they formed in order of battle, and an engagement ensued. The Mamelukes were received with a sudden and steady fire of musket shot, when many of them fell; but they rushed on, and were received by well-directed bayonets, which covered the field with blood and dead bodies of the slain.

The plunder of Murad Bey's camp yielded a seasonable supply to the French army, by furnishing them with camels, baggage, and cannon, together with other articles suitable to their wants; and they also obtained considerable sums of money, with many costly ornaments. In consequence of this action, the French got possession of Giza, with the adjoining country, and the island of Roda. On the following morning, the principal inhabitants of Grand Cairo offered to surrender the city, provided that property, lives, and privileges, were respected and preserved. These conditions they were encouraged to expect, from the proclamation of Bonaparte on his taking Alexandria, in which protection was promised to the Egyptians, and respect professed for the Ottoman religion and government. It was asserted in this manifesto, that the object of the French expedition to Egypt was to suppress the turbulent beys, and restore the legitimate influence of the Grand Signior; but the disguise was too thin to conceal the real intention, and it was unquestionably evident, that the French government were desirous of subduing the country, and adding it to their own dominions.

When Bonaparte entered Grand Cairo, the pasha fled under the protection of Ibrahim Bey; but to keep up an appearance of confidence in the French, the Caya remained at his station, and professedly entered into Bonaparte's views. Murad Bey, with the remains of his troops; fled toward Saceara, and Ibrahim, his colleague in the government, marched with his followers into the eastern parts of the Delta. The motions of each of these chiefs were strictly watched, and it was found that Ibrahim was using his utmost endeavours to increase his army, and render the people hostile to the French. Bonaparte pursued Ibrahim with a numerous army; but the fugitive bey was successful in escaping from the power of his enemy. The circumstances of Grand Cairo did not permit Bonaparte to be longer absent from that city; but he was alarmed, as he was returning, by the report of an engagement which had taken place at Aboukir, between the British squadron and the French fleet. The news were found to be true, and a commenced was made of the disappointments and defeats by which the French forces were compelled at length to abandon Egypt.

The fleet of Admiral Brueys had been disposed in a French manner near the shore of Aboukir. Some fleet British frigates in search of Admiral Nelson's ships, were seen off the coast of Alexandria upon the 21st of July, which gave the alarm; and upon the 31st of the same month, the fleet itself was observed from the Roads of Aboukir. The French ships were moored at a proper distance from the shore, and placed in a curved line, according to the direction of the deep water. The headmost vessel was placed near a sand bank, the line of battle was flanked by frigates, and the van protected by a battery on a small island. No contrivances could have been better formed for placing the French fleet in an exquisite state of defence; but danger and difficulty raised the spirits of Sir Horatio Nelson; and in such situations, his fertile genius opened up astonishing resources.

Shortening sail on a sudden, he directed a part of his squadron to pass between the French fleet and the sand bank, which the republican admiral had viewed as the great security of his vessels. While a part of the British ships penetrated in this manner between the enemy and the shore, others moored opposite them within Nelson's victory at Aboukir.
a small distance; and the French being exposed to a cross and destructive fire, the British were victorious. Having dropped further down on each side of the enemy's line as their success allowed them, the fleet of Admiral Brucey was either destroyed or taken, excepting two ships of the line and two frigates. The Cul-oden having run aground, was prevented from having a share in the action; and thus the British admiral, with eleven ships of the line, and one of 50 guns, had to contend, and contended successfully, with 13 ships of the enemy, all of them of equal, and some of them of superior force. The French admiral had also four frigates, while the British commander had only one brig to employ in expeditious movements. L'Orient, the flag-ship of Admiral Brucey, carried 120 guns. The admiral himself was killed during the action; and his ship having taken fire, was blown to pieces.

Admiral Blanquet succeeded to the command, and several of the officers perished in the conflict. The British lost Captain Westcott, and 15 other officers. The French had upwards of 8000 killed and wounded, while the British loss scarcely amounted to nine hundred.

Sir Horatio Nelson was made a peer of Great Britain, by the title of Baron Nelson of the Nile, and Burnham-Thorp in the county of Norfolk. He was afterwards raised to the dignity of viscount; and after the celebrated victory where he lost his life, additional honours were accumulated on his memory; and his brother William succeeded the hero by the names of Baron Nelson of the Nile and Hilborough, Viscount Merton, and Earl Nelson of Trafalgar; and was added the foreign title of Duke of Bronte.

The court of Constantinople were quite transported with the success of Nelson, and they lavished upon him many honours. Money was also distributed among the seamen of the British squadron. In the mean time, Bonaparte arranged a constitution for the province of Egypt, somewhat resembling the Turkish model; but while the people had the appearance of choosing the principal officers of state, the power of the government was really in the hands of the French agent. Bonaparte met with much discontent of Aboukir, but his presence could be of no avail in that part of the country. The British squadron had sailed from Egypt, and the Mediterranean Sea was swarming with British vessels. Besides, he had an expedition in view, which was conceived in France to be of great interest.

Upon the death of Sheik Daher, Ahmet Aljezzar was nominated and appointed pacha of St John d'Acre. For many years the merchants in Europe had been enlarging their share of the Mediterranean traffic; and the divan of Constantinople was jealous of those encroachments. Aljezzar exercised his power to check the growing commerce; and he had been peculiarly severe upon the adventurers of France. Soon after the battle of Aboukir, the Grand Signior proclaimed war against France; and this formed a pretext for Bonaparte carrying his arms into Syria, which he had formerly been determined to do. His army consisted of 12,000 men, and 10,000 of them were effective troops. He had Generals Kleber, Bon, Lannes, and Regnier, to assist his views, and execute his plans. They met with several obstacles on their march; and had some engagements, but always with success. They first took Alarish; then Jaffa, with several places of inferior consideration; and in the month of March 1799, they took possession of an eminence on the east side of the city of Acre, and upon the 20th opened trenches within a few yards of the wall.

The Pacha Aljezzar was terrified at the approach of the French troops; for the news of their uncommon successes had reached the whole dominions of the Grand Signior; but he was encouraged and kept at his post by the advice and assistance of Sir Sidney Smith. That enterprising officer had been appointed by the British government to co-operate with a Turkish squadron, in bombarding the city of Alexandria, and seizing the French vessels which were in the harbour. Finding that his efforts could be of little avail upon the coast of Egypt, he directed his course to St John d'Acre, on board the Tigre, accompanied with the two frigates, Alliance and Theseus. He was fearful lest the Pacha Aljezzar should yield to the formidable troops of France; and he arrived in time to prevent the failure of which he was apprehensive. Under the direction of Sir Sidney Smith, the troops of Bonaparte were baffled in various attempts to take the town by assault.

A part of the French troops, under Kleber and Junot, found it necessary to leave the siege of Acre, and march towards the banks of the Jordan. When they were hard put to it, Bonaparte himself marched with additional forces to the assistance of Kleber, and afforded effectual aid. Having accomplished his purpose, he returned to St John d'Acre, and renewed the siege with vigour. He made a lodgment in one of the towers, but was repulsed with great loss by the soldiers within, and the British vessels which were moored in the roads.

In the course of a few days, the Turkish fleet made its appearance under the command of Hassan Bey, and it consisted of thirty sail. This addition of strength to the forces of Aljezzar encouraged the Pacha, and sunk the hopes of the French general. After a variety of severe conflicts, in which many valuable lives were lost on either side, Bonaparte was forced to abandon St John d'Acre, after a siege of sixty days.

Having resolved to depart for Egypt, he concealed Bonaparte's design, by incessantly firing upon the town; and in the night-time made preparations for a safe escape. Upon his retreat to Jaffa, he sunk the heavy artillery, which could not be taken along with them in their retreat; and put the howitzers and small cannon on board some small vessels, and thereof with the wounded soldiers, to be conveyed to Egypt. But the heavy ordnance was discovered; and the vessels with the sick and wounded were taken at sea. Troops of cavalry harassed his soldiers on the rear, and bands of Arabs attacked them on every quarter. By fatigue and slaughter, the road was strewn with the bodies of the dead. The troops of Bonaparte burnt the villages as they passed, destroyed the fields of corn, and marked their route by desolation.

In the mean time, Desaix had pursued Murad Bey into Upper Egypt as far as Syene; but though victorious, he could not subdue the Mamelukes, who moved from place to place with incredible swiftness. When Bonaparte returned to Egypt, he found Mamelukes among the pyramids of Giza, but was not able to bring that active bey to a general action; for he retired into the province of Fayum. In the mean time, a Turkish fleet had arrived in the bay of Aboukir, with an army of 8000 or 9000 men. The news were distressing to Bonaparte; and the more so, as he was apprehensive that Sir Sidney Smith, who had defeated his views at St John d'Acre, was present with the Turkish fleet, and ready to assist them with all his activity and skill. But the French commander in chief determined upon an immediate trial of strength and fortune. He marched
his army, with rapid movements, toward Alexandria; and thence he led on his forces to attack the Turkish camp.

Both wings of the Grand Signior’s army were assaulted at once by detachments in advance, and General Murat with his cavalry darted upon the centre. The lines were thrown into confusion, and most of the Turkish army were either killed in the field, or drowned in attempting to reach their ships. The bravery of the Ottoman soldiers, and the determined skill of the French, made the conflict dreadful. After gaining so complete a triumph, General Bonaparte returned to Grand Cairo. There he attempted to tranquillize the people, and to establish a regular and subservient government. He had formerly professed himself attached to the Mahommedan faith; and here he celebrated a grand festival of the prophet with much solemnity. Having finished these arrangements, he returned to Alexandria, professing that the situation of public affairs required his presence, but really with an intention to embrace an opportunity of returning to France.

In the port of Alexandria there were two frigates lying at anchor, and ready for the sea. Some hopes, aided by a natural wish, induced the friends of Bonaparte to encourage an expectation, that the commander in chief was meditating a return to Europe. No intimation was given, not a hint dropped; but upon the morning of the 24th of August, by the dawn of day, his attendants, trembling with expectation, were commanded to wait his pleasure upon the sea-shore. Instantly they were on board, and the vessels under sail, with a fair wind, steered their course along the coast of Africa. At length, having made for Corsica, they anchored in one of its bays, on the first of September. Upon setting sail from that island, they were seen and chased by a British squadron. Gantheaume, who commanded the frigates, proposed to run back to Corsica; but Bonaparte enjoined him to steer for a port in France. The darkness of the night favoured their escape; and upon the 14th of September 1799, they arrived safely in the port of Frejus.

Never was a plan conducted with so much secrecy, and productive of such great events. A note was conveyed to General Kleber, which he was enjoined not to open, till twenty-four hours after the frigate had sailed. In that note, he appointed him commander in chief of the French army in the East, and it contained rules for the general management of public affairs. When Bonaparte appeared at Paris, he was not conscious for leaving his command; nor was the falling authorities call his conduct in question. Change after change had taken place in the French government, according as successive parties had lost their influence; and he arrived in France upon the eve of the seventh revolution, when the Abbé Sieyes was projecting a new constitution for a new party, who were attempting to rise into power. Discontentment ran through every department of the state; and the public successes had been somewhat counteracted, by the reverses in Italy, and the approach of Suvarrow with his hostile troops.

At this momentous conjuncture, Bonaparte joined in the project of Abbé Sieyes, and a form of government was established, with a senate and various nominal authorities. To captivate the people, it had some names and appointments similar to the popular government of ancient Rome, and the office of first consul was vested in Bonaparte. But neither the name nor the authority were commensurate with his ambition; and having at length acquired additional influence, he was proclaimed emperor of France. Considering the elevation to which at this time he was raised, and the state of degradation into which he has now fallen, we shall quote the following passage from a character which was drawn of this extraordinary man in the height of his power.

"Viewing Bonaparte in the exalted station of emperor where he now stands, we shall neither be dazzled by the splendour of his rank, nor inflamed by envy at the greatness of his success; but we shall endeavour to glance, without partiality, at the steps of his military career, and form a true estimate of his character and conduct. As a soldier, he is possessed of undaunted courage, and no man ever questioned the daring intrepidity of his soul; but he is too violent in his passions to enjoy that self-command, and hold those deliberate councils, which distinguish a great and characteristic an empire. Few generals have equalled Bonaparte in point of fame or extent of conquests; and it is not our wish to deprive him of any part of his well-earned trophies. But it does not appear that his merit as a general, is fully commensurate with his progress as a conqueror. The Italian states have long been destitute of that martial spirit, which glowed in the legions of Rome; and having descended from the height of military glory, they have sunk into the lap of indolence, and laid themselves down on the couch of dissipation. They were tainted, too, by the prevalence of democratic sentiments, and their resistance to the French army was rather apparent than real. They were not unwilling to become captives to those distinguished heroes, who promised them liberty and seducing favours.

"The armies of Germany were harassed by the numerous forces of France; for when both were fatigued by severe combats, the French generals brought up extensive corps of reserve, and poured fresh troops upon the exhausted forces of the enemy. But it has also been suggested, that many of the Germans were dazzled with the professed, but false advantages of the French revolution. As examples of Bonaparte’s violence in times of irritation and difficulty, we shall not appeal to instances of indiscreet management in affairs of state; but we shall turn our recollection to St John d’Acre, and bring to our remembrance the hopeless attacks upon the town and fortress towards the end of the siege, when blood was spilt, and lives sacrificed to disappointed ambition and frantic rage. Even the battle of Marengo was indebted for its success to the effects of a daring attempt, which has met with praise, because it was prosperous; but if it had not terminated in a happy manner, the rashness of the proceeding would have exposed the general to pointed blame. Whether Bonaparte and his family will be secured in the honours of a throne, or whether, in the course of events, they shall be hurled from their grandeur, and levelled with the dust, are arrangements of Providence, which lie concealed in the destiny of heaven."
This temper of mind has made its appearance in various parts of his conduct. It was peculiarly predominant in the arrangements, which preceded the battle of Leipsic; and for him it was more fatally displayed, when he refused the terms of accommodation so frequently offered by the allied powers; and continued his infatuated projects, till, for the benefit of the world, but to his own disgrace, he was driven from the throne, and consigned to a residence in the Island of Elba. And to sum up the whole, "heaven gave him a degree of military skill, but without the recommendation of personal bravery; an activity prodigious, but without aim; a will untameable, but without discernment. All his disasters—all the disgraces with which he has been overwhelmed, have sprang from the same causes which produced his triumphs. Nothing was able to soften the character, to correct the false judgment, or to elevate the corrupt soul of this Corsican soldier."

The court of Constantinople were amused with pretensions on the part of Bonaparte; and he hinted to Kleber, who succeeded him in the command in Egypt, that he should still offer to negotiate with the grand Signior, but retain the commercial influence of the country. But the British interest prevailed at Constantinople, and the overtures of the French were rejected. In the meantime, a Turkish division were landed on the coast of Egypt, and entrenched on the sea-side, between the Nile and lake Menzalah. They were attacked by the French, under the command of Verdier, and but few of them escaped. Intimation being given, that no treaty at Constantinople could be made without the consent of Great Britain, commissioners from all the parties opened a conference on board the Tigre, and an armistice was signed.

Soon afterwards, upon the 24th of January, A.D. 1801, a treaty was entered into, by which the French were bound to leave Egypt in a given time; but their private property was to be preserved, and various arrangements made for a safe and honourable return to France. In the meantime, orders had been issued from the court of London, to enter into no convention by which the unconditional surrender of the French army was not acknowledged; and due attention paid to the interest of the Turks. Yet when the treaty of Alarish was communicated to the British councils, the whole was ratified, and orders issued to carry it into effect; but the French commander refused to abide by the terms of agreement. Some deficiencies in the conduct of the Ottoman court, and the first determination of the British, which was to require a surrender of the French army, as prisoners of war, were assigned as reasons by Kleber for not adhering to the terms of the treaty.

These, without other considerations, might have operated on the general's mind; but such objections would soon have been removed, if they had not been strengthened by the recent prosperity of the French affairs. At Grand Cairo and its neighbourhood, a Turkish army, which had marched from Syria, was subdued by Kleber; and, under the new order of things, the internal situation of France was improved. Notwithstanding every effort, the people of Egypt were not tranquillized, and Kleber, the French commander in chief, was assassinated upon the terrace of his own garden at Grand Cairo. Menou succeeded to the command; and he was determined to submit to any hardship, rather than relinquish the conquest of Egypt. He wished to recommend himself to the favour of the first consul, and enjoy the honour of retaining Egypt in the possession of France. In full expectation of receiving supplies from Europe, he carried forward the public works which his predecessors had begun.

But the court of London had planned a secret expedition: Lord Keith was Admiral of the fleet, and Sir Ralph Abercromby commander in chief of the army. It is uncertain what object the fleet was originally appointed, but intervening circumstances finally directed the expedition to Egypt. It touched at Malta, on its way to the place of destination; and was to wait for the arrival of Turkish troops at some of the islands in the Levant. The haven of Marmaricke was fixed upon for the place of rendezvous; but after waiting long, the supplies from Constantinople were scanty and ineffectual. Too much time had already been wasted, and the object of their enterprise must be attempted. To conduct the army from St John d'Are over land to Grand Cairo, would have been the easiest way to penetrate into Egypt; but the French were in possession of Alexandria, and it would have been hazardous to take a station in the centre of Egypt, and permit the direct communication with Europe to be cut off. It was therefore resolved upon, in a general assembly of the officers belonging to the expedition, that they should sail directly for Alexandria.

Early in the morning of February 22d, A.D. 1801, the signal was made for unmooring, and in the evening the whole fleet was under way. During part of the voyage, the weather was stormy, and a Greek vessel foundered. Upon the first of March, in the evening, a signal was made that land was in sight, and in the morning the fleet anchored in the bay of Aboukir. The weather was too tempestuous to permit a landing, and Major McKerris, who had been sent to examine the shore, had been unfortunately killed by the enemy. Abercromby himself reconnoitred the shore in a small vessel, and took every precaution to effect an easy landing. When the sea became sufficiently calm, the first division prepared to land at an early hour in the morning. It consisted of 5000 soldiers, under the command of majors-general Moor, Ludlow, and Coote, together with brigadier-general Oakes. But these preparations could not be made without the observation of the French; and they were ready to receive them with artillery, a large body of soldiers, and a number of cavalry. Though the Fury and Tartarus bomb vessels, with sloops and gun boats, were appointed to protect the landing of the forces; yet they suffered dreadfully from the fire of the French, who opposed them on the shore.

But the British troops displayed the most undaunted valour; and though they were scattered, and could attack the enemy only in detached parties, yet the French forces, after making a stout resistance; under the command of General Friant, were forced to retire. During the course of the day, the most of the troops were landed, and met with no more resistance; for the peninsula of Aboukir was mostly abandoned to the British. Daily skirmishes were happening between the two armies, but no regular engagement took place till the 13th of March. Upon the advance of the British forces, the army of General Menou were discovered in a strong position upon a range of sand hills. Their right extended to the canal of Alexandria, and their
left was supported by an extensive range of ruined buildings. The position was strong, but it was the more necessary on that account, that the British should possess it, and the army received orders to be in readiness for marching by five o'clock in the morning.

When within gun-shot of the enemy's lines, the French advanced with rapid movements; but they were received with determined bravery, and were driven back from station to station till they took their stand near Alexandria, upon the heights of Nicopolis. It would have been desirable to have driven them from that station, and it is believed that the business might have been accomplished; but there were circumstances at that time which induced the British general to decline the attempt. Both armies had suffered severely in the action, though the loss was less serious than might have been expected. Upon the landing of the British forces, General Menou was at a distance in the interior of the country; but being apprised of the danger, he hastened to Alexandria, and arrived from Grand Cairo with 9000 men upon the 20th of March. He determined upon an immediate attack, being confident of success; and Sir Ralph Abercromby was informed by a friendly sheik of the Arabs, that the attack was to be made on the following morning. Every arrangement was made which was suitable to the prospect of so important an engagement.

The army was strongly encamped in the same favourable position which it had taken up after the late engagement, and was disposed of in the following manner. In the centre of the first line were Major-general Ludlow and Coote, with the Royals, two battalions of the 54th, and the 92d regiment. About a quarter of a mile in advance, upon the right, Major-general Moore was stationed with the corps of reserve, which consisted of the 28th and 58th regiments; the 23d, the 42d, and the flank companies of the 40th, together with the Corsican rangers. The left wing reached the canal of Alexandria, which was composed of the 8th and 18th, the 13th and 90th regiments, under the command of Major-general Cradock. Upon the left, near the lake of Aboukir, the staff was placed; and the whole extent of the army was about a mile in length.

In the second line, upon the right, were the Minorca, De Rolle and Dillon's regiments, commanded by Brigadier-general Stewart. In the centre were the 30th, the 4th, and 89th regiments, under the command of Brigadier-general Doyle. Upon the left was Brigadier-general Finch, with the 20th regiment, and both the mounted and dismounted parts of the 12th dragoons. Also the 27th, 50th and 79th regiments, which were commanded by Lord Cavan. The cavalry of reserve were placed behind the troops of General Moore, Captain Maitland was stationed with gun-boats near the beach, and the fleet was cruising off the port of Alexandria.

The French army, in the strong holds of Nicopolis, was arranged in the following manner. The right wing was composed of the 18th and 85th, the 25th, 61st, and 75th demi-brigades, commanded by General Regnier. In the centre were the 21st and 32d demi-brigades, with two grenadier companies of the 25th, and three of the second light battalions, entrusted to the command of General Rampon. The left, under General Lanusse, consisted of the 4th and 18th, the 60th and 88th demi-brigades. The army extended with its right wing towards the canal of Alexandria, and with the left it approached the sea. Behind the centre was a powerful body of cavalry, commanded by General Roise, and in the rear of the whole was a large park of artillery. Early in the morning of the 21st of March, all the troops were under arms; and every officer was at his post. The intelligence communicated by the Arab chief might be untrue; but it related to too important a concern to be neglected. But his information was as correct as it was valuable; for soon after three o'clock in the morning, the report of musketry was heard on the left; and the noise of cannon immediately succeeded; but Sir Ralph Abercromby justly considered it as a false alarm. From the situation of the troops and the nature of the ground, that was not the quarter from which a discerning general would make his attack. Scarcely was this conclusion drawn, when shouts of defiance and clashing of arms were heard upon the right. It was a misty morning, and the division of General Lanusse had almost approached unperceived the position of General Moore. Upon the sea-shore, the French troops made an attempt to enter the ruins occupied by the British 58th regiment; and it was not till they were quite at hand that Colonel Houston could see them so distinctly, through the haze, as to distinguish them from his own men, and direct his fire with safety. General Silly's brigade was engaged with the 28th regiment, and at every point the battle was severe. The 23d and 42d regiments flew to the relief of their fellow soldiers, and the foe was repelled.

General Rampon, with the centre division of the French army, penetrated through the British lines, but was forced to retire with considerable loss. While the French were everywhere giving way, General Roise was commanded to charge the British upon the right, and his cavalry were to be supported by the infantry of Regnier. The first charge, conducted by General Boussart, was bravely sustained, and a second by Roise himself was not more successful. Being repulsed in every quarter by British bravery, the French army retreated, and took up their late position upon the heights of Nicopolis. A French standard, inscribed with many mottoes of victories and trophies, was taken by Anthony Lutz, a private soldier in the Queen's German regiment. This standard was the subject of much contention; but it seems, after every enquiry, that the standard was first taken by Major Stirling of the 42d regiment, and given in charge to Sergeant Sinclair; but the sergeant being wounded, the standard was lost and retaken by Anthony Lutz. Each of the persons concerned had great merit for their bravery in the hour of danger; but Lutz was rewarded with a pension of £20 a year, as being the most suitable boon for his situation in life.

Upon the 21st of March, 12,000 French troops were on the field of battle, whereas the British force was little more than 10,000 men. The French cavalry were well mounted, whereas the horses of the British army were of an inferior kind, supplied by the Turks; and as the French had been in possession of Egypt for a considerable time, they were everywhere better prepared than the British army could be, who had landed but lately on the beach. But British valour and perseverance overcame every difficulty, and taught the republican soldiers of France what they were to expect from the soldiers of Great Britain. Generals Lanusse, Beaufet, and Roise, did not survive the late engagement, and the loss of the French was immense. Six British officers were killed upon the 19th of March, Major Ogle died by the bursting of a shell at the landing of the troops, and Ensign Warren and Mead fell also on that memorable occasion. On the 21st of March, which terminated so honourably to the British name,
Sir Ralph Abercromby, their tried and much-esteem ed commander-in-chief, died after the battle, on board the Foudroyant, Admiral Keith's own ship; and his death was occasioned by the wound of a bullet which entered his thigh, took its direction toward the groin, and could not be extracted. He was lamented by his country, and beloved by his army. His body was deposited in the north-west bastion of Fort St Elmo, in the island of Malta. A monument was erected to his memory in St Paul's church, London; and the king was pleased to command, that the funerary French standard, taken by de Lutz, should be deposited on his tomb. The lady of the departed hero was dignified by the title of Baroness Abercromby of Aboukir and Tullibody, which remained to the heirs male of her deceased Lord. Other remembrances accompanied these honours, and the national feelings were indulged by these merited tokens of public favour.

Upon the death of Sir Ralph Abercromby, Major-general John Hely-Hutchinson, being the second in command, succeeded in course to the office of commander-in-chief. The part he had to act was perilous. To push forward immediately to Alexandria would have been dangerous, and to remain inactive would have been inglorious. To establish a correspondence with the Grand Vizier, who was directing his course to Grand Cairo, and to obstruct the communication of the French with that important city, it was necessary to reduce Rosetta and the strong post of Ramlamiah. Rosetta was of great consequence for defending the navigation of the Nile, and conveying what was necessary to Grand Cairo; and when it was taken, the care of the place, and the reduction of Fort Julian, were given in trust to the Right Hon. the Earl of Dalhousie. The city of Alexandria being put into a respectable state of defence, and the communication of Grand Cairo being rendered more difficult by the water, which was thrown into the old bed of the lake Mareotis, which extended far into the desert, the British and Ottoman troops were attended every where with success.

A party of the French advancing from Alexandria, were attacked by General Doyle and Major Wilson; and being already harassed by the Arabs, they surrendered themselves prisoners, upon the promise of being permitted to return to France. A considerable number of French troops were assembled at Grand Cairo, and a detachment was sent to engage the army of the Grand Vizier, and drive them back to Salehiah. An engagement ensued, and the Turks were victorious. Immediately after this victory, the Grand Vizier encamped at Benerhasset, where Major-general Hutchinson, and the Capitan Pasha went to visit him, and concert measures for the siege of Grand Cairo. Though several skilful British officers were ready to assist the Grand Vizier with all their talents; yet General Hutchinson was fearful of a Turkish army meeting the well-trained troops of France; therefore, as the Grand Vizier advanced on one side of the Nile, General Hutchinson made progress on the other. Seeing these powerful preparations, General Belliard, the French commandant of Grand Cairo, proposed a conference for surrendering the city.

Brigadier-General Hope appeared for Great Britain, Mahommed Pasha for the Vizier, Isaac Bey for the Capitan Pasha, and Osman Bey for the Mamelukes, who were still formidable, though held in check. Generals Morand and Douzelot, with Tareyre, a chief of brigade, were employed in behalf of the French. Captain Taylor was secretary to the conference, and, in the course of six days, a convention was signed for surrendering Grand Cairo. Vessels, and every necessary provision, were furnished for facilitating the departure of that division of the French army; and in the first week of August they sailed from Egypt for their native country. In the mean time, Menou was providing for his army at Alexandria; and General Coote was providing for the British interests both by sea and land.

While transports with supplies for the French troops were not permitted to land, the British forces before Alexandria had received reinforcements and other supplies from Europe. But, after all, Menou refused to comply with the terms which Belliard had accepted at Grand Cairo, and vowed to triumph or perish in the fate of Alexandria. During these transactions, General Hutchinson had been created a Knight of the Bath, and appointed Lieutenant-general of the Mediterranean. As Menou refused to surrender, it was necessary to adopt measures for driving him from Alexandria. The most convenient place for an attack appeared to be the peninsula of Marabu, on the west of Alexandria. This scene of action was fixed upon by General Coote, and he was appointed to conduct the operations, while Sir John Hutchinson commanded the camp to the eastward of the city.

The troops under the command of General Coote were about 4000 rank and file, with a due proportion of artillery and engineers. They pushed along in boats on the lake Mareotis; and to facilitate their landing, a diversion was made by the troops of General Finch, and a successful landing was effected. To distract the attention of the French, General Hutchinson made an attack on the enemy's whole line, upon the heights of Nicopolis, while the western division of troops had taken the fort of Marabu, and then pushed forward toward Alexandria. The French in this situation were strongly posted; but their lines must be forced, or Alexandria could not fall. Upon the 22d of August, therefore, the British troops were under arms by dawn of day, and moved forward in separate columns. Lord Cavon, with Generals Ludlow and Finch, had the principal command of the corps and divisions of that day. Upon the right of the army was the lake Mareotis, with four gun-boats; and on the left the old harbour of Alexandria, with six sloops of war. As the army advanced, so did the vessels on either side, keeping rather in advance, to harass the enemy, and protect the British in their march.

The French soldiers retired, and the British having advanced, formed an encampment upon the ancient Nicopolis. Both sides of Alexandria were invested by the British troops; an accession of ships in the old harbour poured destruction upon the city; and Menou, after various attempts to procrastinate, in the hopes of receiving supplies from home, was compelled to capitulate, upon the same terms which General Belliard had accepted for Grand Cairo, and which General Menou had formerly rejected with scorn. Here, also, Brigadier-General Hope was the person employed to adjust the capitulation; and on the 2d of September the French surrendered. Sir John Hely Hutchinson was created a British peer; and Lord Keith, who had already an Irish title, was raised to a seat in the British House of Lords. General Coote was invested with the order of the bath; and the Grand Signior conferred many favours upon the principal officers both by sea and land. All the regiments who had been in Egypt were allowed to carry a sphyx upon their colours. Upon the 18th of September, the keys of Alexandria were
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delivered to the Turks, but a division of British soldiers were retained, for a time, to garrison the city. There was a deadly hatred between the court of Constantino - ple and the Beys of Egypt; and it was thought to be expedient, as well as humane, to see that the Ottoman soldiers did no injury to the humbled Beys.

The officers of the Grand Signior had determined to ensnare the principal Beys, and carry them to Constantinople; but the plot was discovered, and many lives were lost. The British interfered, and the Beys entered into an agreement to retire into Upper Egypt, within a limited part of the country. But this was only a temporary arrangement; and it must have been obvious, that they would seize upon the first opportunity to return to the fertile plains of the Delta. Their spirits were broken, but their designs were the same; and they must have been anxious to regain their influence, and, if possible, to become masters of the country which they had long been accustomed to keep in control. Accordingly, in 1806, Osman Bey Bordossi, together with Ibrahim Bey, and other chiefs of inferior note, were still in possession of Upper Egypt, and apparently faithful to the treaty they had made, while Elfi Bey, who had then risen to great power, possessed the left side of the Nile, from Sacare to Rosetta. Occasionally the Arabs under his command pushed forward between the lake Mareotis and Aboukir, threatening the city of Alexandria; while Pasha Mahomed Ali, the representative of the Grand Signior, remained inactive at Grand Cairo, and his Albanian soldiers were without pay, and in a state of mutiny.

The authority of the Grand Signior was obviously in a weak condition, when it could not repress the incursions, nor overthrow the power of the turbulent Elfi Bey. Notwithstanding the benefit which the British nation had conferred on the court of Constantinople, in driving the French from Egypt, and restoring the country, without exception or reward, to the Grand Signior; yet the intrigues of Bonparte, who was then subverting kingdoms, and destroying wise and ancient alliances, had found access to the councils of the Grand Turk, and rendered the nation hostile to Great Britain. In this situation, an expedition was fitted out against Constantinople, and another directed to the coast of Egypt. The Egyptian expedition sailed from Sicily on the 6th of March, under the command of Major-General Alexander Mackenzie Fraser. It consisted of the 35th regiment, a battalion of the 31st, and another of the 78th, together with De Rolle's regiment, four troops of the 20th dragoons, three companies of artillery, and two of artificers,—in all about 5000 men, under convoy of the Tigre and Apollo.

In the night of the 7th, or the second night they had been at sea, the Apollo, with nineteen transports out of thirty-three, which were employed in conveying the troops, parted company; while the Tigre, with the other fourteen, anchored to the westward of Alexandria, on the 16th of March. They learned by the Wizard sloop of war, which had been sent forward to receive instructions from Major Misset, that the French consul at Alexandria was endeavouring to prevail upon the governor to admit a body of Albanians for the defence of the city; and that it was necessary, to ensure success, that an attack be made upon Alexandria without delay. Having made the necessary preparations, the British force moved forward in the evening of the 18th, and forced their way through a paled down entrenchment with a steep ditch, which ran from Fort Des Bains to Lake Mareotis. They almost reached, with little loss, the gate of Pompey, which they found barricaded, and the walls lined with armed men. As the party did not exceed 1000, it was thought too hazardous to risk an engagement, and therefore the general directed his troops to the neighbourhood of Aboukir, and took up a position upon the very ground, which Abercrombie's troops occupied on the declared 21st of March. A flag of truce was sent into Alexandria, and the town, with two frigates and a corvette, surrendered to the British arms; and, what is remarkable, were taken possession of upon the morning of the 21st, the anniversary of the memorable victory obtained by the British over the French six years ago. On the 19th, the Apollo, with the nineteen transports, arrived on the coast of Egypt, and entered the bay of Aboukir.

It was stated to General Fraser by Major Misset, his majesty's resident in Alexandria, that the city would be reduced to famine, unless Rosetta and Ramlanik were taken possession of by the British troops. With the concurrence of Admiral Sir John Duckworth, some British troops, with the Chasseurs Britanniques, under Major-Generals Wauchope and Mead, were detached and appointed to perform that service. They possessed themselves of the heights of Abourmandour, which commands the town, and suffered no loss; but having entered the town, they were severely attacked from the houses in all quarters. General Wauchope was killed, and General Mead severely wounded. They retired to Aboukir, and from thence to Alexandria; and, upon the urgent representations of the magistrates and people of Alexandria, another attempt was made to occupy Rosetta, but the enterprise was again unfortunate. The detachment marched by the wells of Aboukir and the village of Edko; and having taken possession of Allamet, a village where the enemy occupied a post, they marched on to Rosetta, and drove the Turkish soldiers into the town. It was summoned to surrender; but the summons was despaired, and General Stuart, who commanded the troops, was obliged to retreat to Alexandria, with the loss of about 1000 men, killed, wounded, and missing. This enterprise was unfortunate on two accounts; first, because powerful reinforcements had arrived for the Turks from Grand Cairo, which gave them an advantage; and secondly, because the Beys had not joined the British, as they were led to expect. They were anxious that neither the Turkish nor British forces should be masters of Egypt; for they were desirous themselves of independence; but on the present occasion, they were unable to obtain it, and therefore leaning to the strongest side, they surrendered, and made a treaty of peace with the viceroy of Egypt.

The British ministers had been misinformed with respect to the Turkish forces in Egypt, as well as the disposition of the Beys; and not having supplies at hand to give them the necessary support, when pressed by superior numbers, the expedition was rendered of no effect, and the enterprise was abandoned. Much has been said of the advantages which might be derived from Egypt as a province; but it is a question whether a settlement in that country would be of real benefit to Britain; as the trade of the Mediterranean is sufficiently open to us in the time of peace; and the Indian commerce, which of old flourished in Egypt, is more conveniently carried on by a different route. But the government of Egypt is miserable and depraved, and stands much in need of some renovating power to reduce it to order and happiness.

See Devon, Berth. Memoir, Baldwin, Walsh, Anderson, Regnier, Sir Robert Wilson, Dr Wilson, and Annual Register. (J. W.)
Part II. Statistical Account of Egypt.

Properly speaking, Egypt is a part of Africa, being included within the same natural division of the globe; but, from its particular situation, and the importance which it once held in the scale of nations, it is generally described in a more independent and particular manner. It is bounded on the east by the isthmus of Suez and the Red Sea, on the south by Nubia, on the west by Libya, and on the north by the Mediterranean Sea. It commences on the south about 23° 45' of north latitude, and at Rosetta terminates at 31° 27', being in length about 500 miles, from south to north; and some parts of it 250 in breadth, comprehending the greater and lesser Oases. But this extent is merely nominal in point of value: the principal parts of the country being the Delta, or lower part of Egypt; and the valley of the Nile, in the higher parts of the country, which is comparatively of a small breadth, being bounded on both sides by high hills or abrupt banks.

The mountains upon the east of the Nile extend to the Arabian Gulf, and are only inhabited by Bedouins, or travelling Arabs, who pitch their tents here and there, as circumstances require; for water is scarce, and vegetation scanty. Across these mountains is a dreary road to Cosseir, which is a sea port of the Arabian Gulf; but the intercourse between that and the Nile is neither ready nor frequent. The principal towns and villages are upon the eastern side of the Nile; for, in going westwards, you soon meet with a sandy desert, with here and there occasional spots of verdure, which are called Oases, or islands, among the sand, when they amount to a size that deserves the appellation. Even Alexandria is hemmed in by the burning sands of the sterile desert; while the Delta is a most luxurious tract of land. The soil is rich, being of a pure black mould, unctuous, and stands in need of little or no manure. It is called the Delta, from the shape which it bears to the letter in the Greek alphabet of the same name.

It is evidently formed, at least in part, of an alluvial soil; but we cannot suppose, that the earth to any depth was formed by the deposition of matter carried down by the streams of the Nile. In the early state of the earth's surface, more loose earth might be carried down by the streams than there can be at present; but we are not persuaded, that any accession of this nature could be sufficient, in a given time, to convert a bay of the sea into an expanse of land. We are rather to suppose, that when this world was brought into shape, it consisted of sea, dry land, and marshy districts. When these swampy parts lay low, and bordered upon the sea, they would be occasionally overflowed; and hence a comparatively small addition of alluvial matter might gradually raise them above high water-mark, and permit them to become dry and arable land.

It is not, however, unlikely that shallow places of the sea have been forsaken by the water, which could soon and easily be cultivated. We do not mean, that the waters of the sea have been diminished in quantity; for if this were the place for such discussions, it might be shewn, that the rains and streams are sufficiently adequate to supply the quantity which is lost by evaporation and absorption. Chemical operations which take place in the atmosphere, contribute more, perhaps, than the rarefied fluids of evaporation, to produce those abundant rains, which supply the springs and streams of water that run into the sea, and maintain its bulk. While the quantity of water remains the same, certain portions of the sea may be converted into valleys, by the water of the ocean being drawn off to supply new spaces; or, in other words, to form new branches or arms of the sea. Convulsions of nature are supposed to have opened up new valleys, or considerable expanses of low lying lands, into which the waters of the ocean ran, and converted them into seas. Such is supposed to have been the case with the Red and Mediterranean seas, and with several bays and inlets on the continent of America. And this may account for such alluvial flats as the Delta of Egypt, and many other districts of the world, which have evidently been derived from the sea, and still exhibit remains of marine productions.

The Delta of Egypt may be higher above sea water-mark at present than it was in early times, from the effects of the earth accumulated by the annual decay of luxuriant vegetable productions; but we believe, that the progress in this respect is extremely slow, if at all perceptible. As much earth may be washed off by the streams which overflow it, as is deposited by these waters, or occasioned by vegetable products. The difference of cubits in the rise of the Nile, which was necessary at different times to water the Delta, sufficiently for producing luxuriant crops, are rather to be ascribed to different lengths of the cubit, than to any visible difference of the height of the Delta above the general channel of the Nile.

This river requires particular notice, from its importance to the fertility and general prosperity of Egypt. In times of ignorance, many absurd ideas were entertained respecting the origin and source of this celebrated river. About 7° south of the boundaries of Egypt, two rivers unite their streams, to form the copious waters of the Nile. One of these is called the Bahir Alabiad, which rises in the district of Donga, belonging to the Gebel Alcomari, or Mountains of the Moon, in the 8th degree of north latitude. It is also called the White River, from the tinge which its waters acquire from the nature of the channel over which they flow. The latter is the Bahir Alazrek, or Blue River, whose waters are clear; which has its origin from some springs in the province of Geesh, in the 11° of north latitude. The White River takes its rise about 3° nearer the line than the Blue River; and the former is three times the size of the latter; and yet Mr Bruce ascribes the origin of the Nile to the province of Geesh rather than to the Mountains of the Moon.

There have been more disputes and sarcastic humour on this head, than the merits of the case deserve. One part of the waters of the Nile rolls its course from the Mountains of the Moon, and another from the province of Geesh; and the question is merely this, which of these places is to be esteemed the source of the Nile? It is far from being uncommon for a river of note to derive its name from the smaller of two branches which compose its streams; and the argument would hold equally good, whether the difference be six or six hundred miles. That the waters of the Nile have their original source in the Gebel Alcomari, is certain; but the question is, how and when the Nile derived its name? The word Nile, in some of the Eastern languages, means the Blue River; and as the Bahir Alazrek, which rises
The Lake Sherun, supposed to be the so much celebrated Meris of old, is now of small moment, and affords but a scanty subsistence to a few miserable fishermen. This lake is near 40 miles in length, and six in breadth; and some have supposed that the Bathaun, which appears to have been artificial, was the Meris of the ancients. As to the Babib-Delta-Ma, or river without water, it seems to have been originally a channel for conveying water from the Nile to the adjoining plains, which, in happier times, were well watered and fruitful. The higher and unwatered parts of Egypt are extremely barren; but the banks of the river are capable of high cultivation, and the fruitfulness of the Delta has been long and justly celebrated.

The appearance of the Delta is luxuriant; but the palm and the date tree, to be seen everywhere, is uniform and fatiguing. The orange groves about Rosetta have been much celebrated; and that perhaps is the most delightful scene upon the Nile. Wheat and barley are produced in profusion, with little agriculture, and that of the simplest kinds. Oats are scarcely known in the warmer countries; and the Delta abounds with rice, lentils, and maize. Dates and oranges, citrons, and various kinds of pulse, are common productions, in the well cultivated parts of Egypt. Two or three different kinds of crops may be obtained annually.

The Egyptian sycamore was probably imported from Arabia, and is much valued for its shade, as well as for its fruit. It grows with little moisture, and flourishes on the frontiers of the sandy desert. The date, the palm, the bread tree, the pistachia, and the Oriental plane, are highly ornamental in the vicinity of their towns; and the cypress overshadows the tombs of the dead. The caper-bush also grows profusely among the ruins of Egyptian buildings; and the henna is abundant, from which the women prepare the yellow dye for tinging their nails. The papyrus, once so famous and common in Egypt, is no longer found in its borders, unless it be the cyprus papyrus of Limnea; but the lotus, sacred to their gods, is found in abundance in all the canals and shallow pools, when the streams of the Nile retire. In Egypt, too, are found the almond and the apricot, the fig and the orange, the pomegranate and the peach. Melons and gourds grow to perfection, and are highly valuable for food. Cotton, and the sugar-cane, together with the plantain, and other productions of different countries and climates, have been imported to Egypt; and as they thrive well with so little care, they would be of great importance under different treatment; and with proper cultivation, Egypt might flourish with the most favoured climates.

The situation of Egypt upon the globe makes it always warm; and at certain seasons the heat is intolerable. From March till November, the mercury in Fahrenheit's thermometer rises in the shade to 86 or 88 degrees. This being the case in the Delta, the heat is more intense in Upper Egypt, where the earth has little, and in some parts no vegetable clothing, but abounds in arid sands and burning rocks. In this situation, the thermometer never indicates a lower temperature than 59°, and seldom less than 52°, even in the coldest season of the year. This excessive heat is partly occasioned by the distance of Egypt from the ocean, and by the moderate height of its hills; for in the bosom of the line, where the mountains are high, the cool air descending from these high regions refreshes the country, and moderates the climate. And we may add, that the air is never cooled by copious rains; for if we ex-
cept occasional showers on the coast of the Mediterranean Sea, which happen in the months of December, January, and February, scarcely a drop of rain falls through all the extent of Egypt. A slight shower in any other part of that vast country is a rare occurrence, and seldom seen by the most aged and observing.

This peculiarity in the circumstances of Egypt, must be accounted for by natural causes; and though we cannot pretend to detect every arrangement which tends to produce so striking an effect, yet there are certain causes obvious to reflecting and philosophical minds, which are sufficient to shew in what manner this occurrence takes place. "The tendency of the air," from the cooler regions, "to fill up the rarified space between the tropics, not only produces the monsoons and trade winds, but also assists us to offer a reason for the deficiency of rain in the districts of Egypt. Being partly within the extent, and altogether within the influence of the northern monsoons, the clouds of that quarter are hurried toward the equator from the month of April to October, and, being carried both rapidly and high, none of them descend upon Egypt, where there are no lofty mountains to attract them, nor do they let fall on its surface any part of their burden, but leaving it unvisited and dry, they hasten to the mountains of Abyssinia, and there deposit their watery stores. The heated and rarified air between the tropics necessarily ascends into the higher regions of the sky; and, yielding to the thicker atmosphere, by which it is displaced, it is driven towards the northern mountains to be loaded with vapours, and to return in a lower direction toward the equator." (Dr Wilson's History of Egypt, vol. i. p. 19 and 20.) But though rain seldom falls in Egypt, yet the dews are exceedingly copious, and refresh the ground.

The comforts of Egypt are diminished, by being subject, in some degree, to that suffocating wind of the deserts, which spreads terror and desolation. It is called the sumiel, the sinnoum, and the chamiss. It is announced by a lowering, troubled sky, and sometimes by a hissing noise. Its heat may be compared to that of a newly opened oven, and its effects are always distressing, and sometimes insupportable. It hardens the skin, and destroys the vegetable growth. It affects the lungs by its pernicious qualities, produces convulsions, and sometimes death. It is felt in Africa, India, Syria, and Arabia; and it reaches Italy in a more modified condition, where it is called the sirocco, and is guarded against with anxiety and care.

Every where the human race are subject to diseases, and in Egypt some of them appear in their worst forms. The leprosy, with which the people of that country are frequently affected, does not seem to be so virulent as that which was spoken of in old times. But the diseases of the eyes are violent and dangerous; and a considerable part of the people are occasionally affected, and sometimes so severely, that some of them lose one, and others both of their eyes. The British soldiers brought this disease with them to Europe; and it is to be hoped that the attention of our experienced surgeons has paved the way for moderating the dangers of the disease. The sources of this affection are not well ascertained, though it has been supposed, that it is owing to the small dust with which the air is impregnated, and especially to the nitrous particles with which the soil of Egypt abounds. It may partly be ascribed to the habit of sleeping in the open air, and being exposed in the daytime to the excessive glare of the reflected sun. Guarding against these inconveniences, will promote the health and comfort of the inhabitants. But of all the diseases which affect this or any other country, the plague is the most alarming. Like other fevers, it is supposed to proceed from miasmata, or putrid effluvia, and it spreads its infectious matter in the air. A high degree of heat, as well as the application of cold, is said to abate its violence, and remove its effects. It has frequently been found, that the free access of cold air has removed the symptoms; and we have no doubt that using the cold bath would be found to be efficacious.

There is no room for mineralogy in the district of the Delta, nor does the valley of the river, in any part of its course, afford subjects for the investigation of that science; but the mountains and higher grounds on each side of the river, yield many curious specimens of the fossil kingdom. The rocks, which form the banks of the lower part of the Nile, are all calcareous, and those on which the pyramids stand abound with shelves, but above the town of Esneh they consist of freestone of various qualities. The chain of mountains on the right, or Arabian side of the river, furnish granite, porphyrites, porphyry, and traps. Here too are found porphyrites, porphyrin, and various kinds of breccia. It was a species of the pudding-stone of which the colossal statue of Memnon was formed at Thebes, which, according to ancient tradition, emitted various sounds at the rising or setting of the sun. Granite or primitive rocks are found in Egypt, but they chiefly prevail toward the southern parts of the country. One of the mountains toward the Red Sea, is called the Mount of Emeralds, and precious stones had formerly been obtained from that part of the country; for those of the best quality are still called by the Persians, the emeralds of Alsaid. Among the fossil specimens of Egypt are found felspar, hornblende, lapis-lazulis, marble with veins of silver, mica, amethyst, cakedony, carnelian, onyx, Jasper, sienite, &c. In the isthmus of Suez there are various silicious fragments, which serve as a bed for those curious Egyptian pebbles, which, when cut, exhibit portraits, branches of trees, ruined buildings, and other imitations of nature. Egypt does not abound in metals, yet iron as well as manganese has been found there, and it is obvious that lead and copper had formerly been worked in its mines.

The animals of Egypt are little different from those of other countries in a similar situation. The native horses are well made, and by proper care might be rendered highly valuable; but they are rather neglected for the Arabian horses, which the Turks prefer on account of their fleetness and spirit. Upon the rich pastures of the Delta, the ox, the cow, and the buffalo are found in perfection. Sheep and goats have also their proper pasture, and are found in numbers. Bees, insects, and reptiles, are also abundant; and the lakes, as well as the sea and the river, abound with fish. In this country the ass is of considerable beauty, as well as strength, and is employed for riding and various useful purposes. The ibis, so much revered in Egypt formerly, is not to be found in that country at present; but from the bodies which were so carefully preserved by the ancient Egyptians, it appears to be a curlew, and not a species of the stork.

Few countries abound so much with ruins as Egypt. Antiquities, which do not only shew its former importance and glory, but is a sad memorial of the reverses and degradations to which human affairs are constantly exposed. The situation of Canopus and Zanis, with other places of note, may be sought for in the Delta; but the prin-
capital memorials of ancient times are to be found in the more early inhabited places of the country. The remains of Denderah, anciently Tentyris, indicate a greater variety of ruins and wrecks of former arts than any other place of Egypt. Though it does not appear to have been the capital of any district, yet it must have been a highly favoured residence, and under the special protection of the kings and nobles of the country. But the ruins of Thebes are peculiarly the objects of our attention, as deriving a higher degree of interest from the antiquity of the city, and the rank which it held as the seat of royalty and science.

Yet even here one might be astonished to find such scanty remains of a city, so great and so famous; but ancient towns, and even the most celebrated cities of remote times, contained few buildings which were calculated to stand the ravages of time. Excepting temples, palaces, and other public edifices, the other buildings were composed of mud or some perishable materials, which were easily swept away by the current of events. And this may be assigned as the reason why cities, like the far-famed Troy, have been entirely destroyed, and the place where they once stood scarcely ascertained. The situation of Thebes is sufficiently known, but little more of it remains than the ruins of its public buildings, its vaulted receptacles for the dead, and some huge specimens of statuary, which command our admiration. The colossal statue of Osymandius, with the two figures, one on each side, which are supposed to represent his wife and daughter, are still seen, and have often been described. Near the same city, an enormous figure, 75 feet high, is described as the celebrated statue of Memnon. Though all these representations are only founded on conjecture, of one thing we are certain, that whosoever this and the preceding statues represent, they belong to ancient times, and are memorials of the progress which in those days had been made in the fine arts. The excess which their proportions bear to the productions of nature, is a proof of rudeness of conception, and a deficiency in taste and imitation. Still, however, in the remotest times, Egypt was eminent for its knowledge and acquirements.

The paintings in the tomb of Thebes have wonderfully preserved their colours, and are specimens of Egyptian ingenuity. They have also a tendency to exhibit the fashions and designs of furniture which were known in those early times. Since the French and British expeditions, we have imitations of Egyptian vases and carpets, chairs and couches, as well as other articles of Eastern production. The ruins of the temple at Carnak, and the magnificent remains of Luxor, are curious and astonishing; but they are neither so chaste nor elegant as the designs at Esnah, Edfu, or Tentyra. Though all the Egyptian relics are ancient, yet there is a difference in their style, and an evident progress from the more rude to the more refined. Girgeh, which is now the capital of Upper Egypt, is comparatively a modern town, and not productive of antiquities; but it derived its name from a monastery dedicated to St. George, more ancient than the town, and built in an early part of the Christian era. The Isle of Philae, at the entrance of the Nile into Egypt, is interesting for many ancient remains, which have been well exhibited by M. Denon, in his splendid and faithful account of monuments, remains, and antiquities of Egypt; and Elephants cannot be passed over without notice.

Memphis has suffered so completely in the lapse of ages, that, like many other ancient cities, it is a question of some curiosity where it was situated. It is most probable, that it stood between the pyramids of Giza and Saccara; and as it was of great extent, its suburbs may have stretched themselves toward both those places, and comprehended within its bounds Mohammon and Metraheny. Upon this supposition, those ancient depositories of the dead, which are found at the pyramids of Giza and Saccara, may have been the burying-places of the dead; without the walls of the city, according to the practice of ancient times, and in this situation, there have been discovered vast excavations and numerous mummies. In the article of antiquities, we speak not of Damietta and Rosetta, though they were ancient stations upon the branches of the Nile; but they were rather the resort of sea-faring men, than the abodes of literature or science, and consequently afforded few works of splendour or art to be handed down to succeeding times.

Although Alexandria was built for the accommodation of trade, and became the emporium of foreign merchandise; yet it also became the residence of kings, and flourished with grandeur and the arts; and now, in its forlorn condition, it exhibits many curious remains, which command our reverence, while they excite our regret. The ancient Pharos was a superb building, worthy of kings, but it has long ago been utterly destroyed; and the present Pharos is an inferior fortification, at the end of a causeway projecting into the sea. Upon the shore, to the eastward of this tower, are two obelisks or Cleopatra's needles, above 70 feet high; one of them continues erect upon its base, while the other has been overthrown, and was partly sunk in the sand, till Lord Cavan, after the British victories, had it raised from the earth, with the view of transporting it to London. Not being able to have his design accomplished, he deposited various specimens of British and Turkish coins in the hole of the pedestal, where the shaft had been inserted, and covered them with a marble slab, upon which was inscribed an account of the British exploits in subduing the French and recovering Egypt for the Grand Signor. These obelisks are inscribed with hieroglyphics, which might assign them a very ancient origin; but it is impossible to determine whether they have a just claim to such antiquity, or whether they were constructed to adorn the royal buildings of the Ptolemies, and afterwards dedicated to Cleopatra. As to the hieroglyphical figures, they may only have been imitations, and performed with the view of giving the obelisks an air of antiquity. But to whatsoever age these or other obelisks of Egypt may have belonged, it will continue to be a matter of astonishment, how such vast pillars were hewn out of the rock, conveyed to their place of destination, and in those times of little knowledge in mechanics, how they were elevated, and placed securely in an erect attitude.

Nearly on a line with Pharos, without the walls of Pompey's ancient Alexandria, and not far from the lake Mareotis, pillar is the magnificent pillar of Pompey. Its height is about 90 feet, whereof the pedestal is 10, the base above 5, the shaft rather more than 63, and the capital completes the rest of the measurement. Its principal parts are of the Corinthian order, though the proportions and ornaments are of a mixed species. This superb monument has been ascribed to Ptolemy Philadelphus, in memory of his beloved Queen Arsinoe; and others have assigned it to Ptolemy Euergetes. A few have supposed, that it was erected for the Emperor Adrian or Severus, while the power of Rome prevailed in Egypt; but the Greek inscription upon the column dedicates it.
to the Emperor Diocletian, under the government of Pontius, the prefect of the country. Ignorance might ascribe its origin to different persons of note, and flattery might dedicate the building to persons of influence or authority, in the same manner as Sonnini indulged a hope, that the pillar in question might in time be denominated the pillar of the French. But why should not the name lead us to the founder? It is called the pillar of Pompey, and might be erected to his memory; for we know that Caesar not only lamented his death, but ordained honours to his memory, and, by the assistance of Cleopatra, his favourite, he might easily accomplish the thing which he desired, although expensive and superb. But Dr White of Oxford supposes, that it was originally connected with the temple of the god Serapis; and if his conjecture be true, its erection must have been in the time of the Ptolemies, and it might afterwards be named in honour of Pompey; and his head, which was presented to Caesar, might be deposited there, and the building afterwards held sacred to his name.

The vaults in Alexandria are monuments of ancient designs for public convenience. The celebrated well of Joseph, at Grand Cairo, is of the same description, and the mikwees at Roda for measuring the rising of the Nile, is a building of considerable elegance, and a remnant of the Saracen grandeur.

The pyramids of Egypt have been more taken notice of than any other ancient monuments of that country. Of the various pyramids of Giza, on the Lybian side of the hill, and nearly opposite to Grand Cairo, there are three, which, for their size and notoriety, more especially demand our attention. The height of the highest has been differently represented, and owing to incorrectness, or different standards of measure, it has been stated at all the gradations from about eight hundred to five hundred feet. But perhaps the height of the three greatest pyramids may be stated in the following manner:—the first at 477 feet high, founded by Cheops; the second at 428 feet, ascribed to Chephrenes; and the third, which Misherin is supposed to have built, is about 160 feet high. St Peter's church at Rome is 437 feet high, and therefore is 40 feet lower than the highest pyramid of Memphis. St Paul's, in London, is 344 feet in height, and consequently is 193 feet lower than the first pyramid, and 93 feet lower than St Peter's church at Rome. The stones of the pyramids are shaped in the form of prisms, and there are various passages and chambers within; at least such have been found in the largest one at Giza.

Further to the south there are other pyramids, which shoot far into the deserts of Lybia, and are generally called the pyramids of Saccara. These erections appear to be more ancient than those about Giza. They are less perfect, and some of them are formed of unburnt bricks. The most ancient bricks of Egypt were only dried by the heat of the sun; and that they might stick more closely together, the clay was mixed with chopped straw; and hence the Israelites, while in slavery in Egypt, made use of straw in making bricks. There are also pyramids in India, and one at Benares is formed of earth and covered with bricks. A pyramid at Medin, in Egypt, is formed of different stories, every one less than another, as it rises in height; and in this manner, it is said that the followers of Buddha constructed their pyramids in India. Such was the form also of the tower of Babel. The antiquity of the pyramids is not easily ascertained, and Diodorus Siculus says, that in his time some of them were 1000 and others 3400 years old. Neither are men agreed in their conjectures about the original design for which the pyramids were built. The greater number are of opinion, that they were erected for the tombs of kings and conquerors, which should hand down their memory to the latest posterity, and preserve their remains inviolate. Others have imagined, that they were meant for altars of the gods, and that their tapering form was in imitation of flame, as the Persians and other nations worshipped fire. It is well known, that the Brahmins consider them as connected with religious ceremonies. While others imagine that they were constructed as a permanent memorial of the proper length of the cubit, of which it is said, that all their dimensions contain a certain number of multiples. But one thing is certain, that they were constructed on scientific principles, and give evidence of a certain progress in astronomy; for their sides are accurately adapted to the four cardinal points.

The present inhabitants of Egypt may be divided into Copts, Beduin Arabs, Mamelukes, Europeans, Musulmans, and Jews. The Copts are descended from the original inhabitants of the country, who in early times dwelt in caves, and their descendants are very different in their appearance from the native Africans. Their eyes are dark, and the nose frequently aquiline; and though the hair be sometimes curled, yet they are evidently a different race of people from the negroes. The present Coptish race have a dusky complexion like the Arabs or Indians, and seem to be the same race of people as those of which the mummies are preserved. The Egyptians, and the people of Hindostan, appear to have one common origin. The Persians and Indians, the people of Egypt and Ethiopia, are said to be descendants of Ham, the son of Noah. Different sons of that patriarch are thought to have separated into Ethiopia, India, and Egypt, &c.; while others maintain, that the latter country was peopled from Hindostan. Several circumstances point out the Persian Irac, and the high country above Thibet, together with other adjoining places, as the regions of the world which were most early inhabited, and from which the people sprung who settled in Egypt, India, and other early civilized countries of the East.

Egypt having suffered so many changes of circumstances and masters, was exposed to the intrusion of different people; and we have found, that its present inhabitants are of different nations. The Beduin Arabs are a wandering class of Arabs, distinguished from their countrymen, who have become stationary in some situation or other, and join in trade, or in cultivating the fields and other arts of life. The Beduin Arabs are still in the pastoral state, like the patriarchs of old; but they have not their simple and pure manners, nor the moral and religious principles for which the Jewish patriarchs were renowned. Many relics of ancient habits are still preserved among the Beduins, but they are a predatory race of people, and stand much in need of religion, good laws, and civilized usages. They chiefly dwell in the higher parts of Egypt, removing their tents and their herds, their cattle and their camels, to the vicinity of wells or streams of water, where they find drink, as well as better pasture; and at certain seasons they are permitted, upon specified conditions, to descend into the lower parts of Egypt, where their herds feed on the luxuriance of the Delta; but they never penetrate far into the country, for they are always ready to dart into the wilderness, when they have committed any act of violence or injustice, which
they frequently do, and which would bring upon them the vengeance of the inhabitants and laws.

The Mamelukes are a race of people whose origin has already been explained, and who were introduced into the country by their Turkish masters, in the capacity of slaves, and having become numerous, acquired so much property and influence, as to threaten the existence of the Mahomedan government in Egypt. Their numbers are still maintained by slaves imported from the unpolished countries of Georgia, and the neighbourhood of Mount Caucasus. But since the grand signior was restored to his former power in Egypt, after the intrusion of the French into that country, the influence of the beys has been exceedingly reduced, and the number of the Mamelukes is upon the decline. The rest of the inhabitants are Jews and Mahomedans, or Christian merchants, who reside in the principal parts of Egypt, for the benefit of trade and commerce.

The fertility of Egypt has long been celebrated, and the number of its inhabitants is proportioned to its produce. The simple manner of living which the native inhabitants observe, is well fitted to increase the population, for it is a well known fact, that the inhabitants of a country increase in proportion to the ease with which their food and accommodation can be procured. In the most prosperous and highly favoured condition of Egypt, when the people lived in ease and safety, under a powerful race of native kings, the population must have been more numerous than in its future state of distraction and violence; more especially under the injudicious government of the Turks: but the number of inhabitants assigned it in very ancient times, appears to be extravagant. Notwithstanding the excessive population of China, which may be in a situation similar to the ancient condition of Egypt; yet we can scarcely believe that Egypt ever contained, at one time, 20,000,000 of people, or even 7,500,000, as other authors have maintained. Grand Cairo, which is supposed to comprehend more than the eighth part of the people of Egypt, is not said to contain 500,000 persons, but, perhaps, the whole may be fairly reckoned at 2,500,000.

To give us an idea of its ancient population, we are told, that it contained from eighteen to twenty thousand towns; but the most of these, if that number did really exist, must have been only scattered villages of small extent and little population. For although Egypt is a country of considerable extent, yet the places which are capable of cultivation are but limited, and, making every allowance for the times of its greatest prosperity, could not have comprehended more than an extent of 6000 square miles.

Among all the improvements which have pervaded every department of life, the art of agriculture has, perhaps, made the least general progress. At any rate, there is much to be done even in the most enlightened countries in Europe. And if there be such deficiencies, where nature needs so much aid, and where knowledge has made so much progress, how lamentable must be the defects in more favoured climates, where nature does so much of her own accord, and where the human mind remains in a state of inferior activity! In Egypt, as well as in other countries of this description, the state of agriculture is low; and yet, from its natural fertility, it has often been found to give ample supplies to other countries. The government of Egypt, and the condition of its people, are unfriendly to great exertions either of body or mind, and, consequently, the manufactures of Egypt are few and inconsiderable.

The country of itself produces an abundance of salt from the different mines, and though not pure, it obtains a ready and extensive sale. Much of it is tinged with a red colour, mixed with a portion of calcareous tares; and by the inhabitants of the country it is called natron.

This becomes an article of commerce, with little labour to the people. But they have considerable manufactures of sal-ammoniac at Giza and Rosetta. But their chief manufactures consist of linens, woollen, and silk goods. They spin their yarn with the distaff, and are altogether unacquainted with machinery, which is so valuable and effectual in Europe. The fine linens of Egypt were formerly in the highest estimation, and far excelled every other manufacture of the kind; but now the linens of that country are chiefly of a coarser texture, and fit only for the more common purposes of life. The fine linens have yielded to the manufacture of muslin, which is generally worn by the higher classes of the people, being not only more fine and showy, but better fitted for the nature of the climate. Among their woolen goods, they form beautiful carpets, upon which they sit in the divan, or in the halls and houses of the great. Their silk is chiefly brought from Syria, and is manufactured into goods after various patterns, such as tafetas and satins; but all their goods of this sort are inferior to those which are brought from India. The Egyptian dress is a shirt, bound about the middle with a kind of girdle, with an upper loose garment, more or less warm, according to the season.

The polishing of flints and precious stones is a considerable business in Egypt, but is chiefly performed by Jews, and the Copts are excellent merchants, clerks, and accountants. Formerly the Egyptians excelled in the art of dyeing, and they imparted colours to glass and crystal of such exquisite hues, that it was difficult to distinguish them from valuable stones. Glass is at present manufactured in Egypt, but it is chiefly of an inferior kind. Their mirrors are small, and glass windows are seldom used in the country. Glass beads of diversified colours form an article of traffic, but they are made at Venice, and are transported to India and the interior of Africa, where the women adorn themselves with these bawbles, as the ladies in Europe and Constantinople do with jewels and diamonds. The Egyptians might excel in the making of glass, because their country affords the best materials which that manufacture requires: but they are deficient in the knowledge of that art; and the fuel which they employ being only straw or other feeble combustibles, is not of sufficient strength to melt with propriety the articles which are necessary for forming elegant glass. With the exception of a few trifling articles, they have no manufacture of iron-ware, and every thing valuable in the art of cutlery comes from the markets of Britain, France, or Germany.

Few situations are more convenient for commerce than Egypt; and it was this conviction which induced Alexander the Great to found the city which he called after his own name, and which he intended to be the capital of his conquests. His quick discernment enabled him to see the means which it possessed of being a commercial centre for Asia, Europe, and Africa. His unexpected death prevented the execution of his schemes, both civil and warlike; but under the government of the Ptolemies, Egypt acquired the commercial ascendency which Alexander foresaw, and which its situation was calculated to bestow.

The princes of this new dynasty encouraged a spirit of enterprise; and from the ports of the Red Sea vessels
launched out in pursuit of new countries and new commerce. Being small, and the sailors unacquainted with the principles of general navigation, they were obliged to sail along the coasts, and move cautiously from one point to another, seldom or never losing sight of land. But with all these disadvantages, they made considerable advances in trade and riches. Moving along the coast of Africa, they darted over to Madagascar; and some of them entering the Persian Gulf, conveyed their goods by the Euphrates to the Persians and other people of these regions. Some penetrated to the mouths of the Indus, visited the coast of Malabar, and reached the Island of Ceylon. There were a few who passed over to the coast of Coromandel, and reached the Ganges.

These Egyptian adventurers exported to India silver and iron, copper and lead, together with some kinds of glass. They also furnished them with woollen goods and other articles of inferior importance. And in return brought from India ivory and ebony, silks, and printed or stained linens, pearls, and precious stones, cinnamon and nutmegs, frankincense and diverse valuable perfumes. To facilitate the conveyance of that merchandise to Alexandria, a canal was cut, from the Red Sea to one of the branches of the Nile; but when that enterprise was unsuccessful, the goods were landed at the port of Berenice, and conveyed from thence across the country to the Nile. To accommodate the travellers and caravans, wells were dug, and resting places provided by royal munificence. By caravans, the different countries of Africa threw the riches of their trade into Egypt, and Alexandria became the most valuable centre of merchandise in the world. It was owing to the riches derived from this traffic, that the sovereigns of Egypt maintained their greatness amidst so many indiscretions, and that Cleopatra, when the empire was shaken to its foundations, was still able to be so splendid and profuse.

Every nation that enjoyed the means of commerce with the Mediterranean, derived pleasure as well as profit from the commerce of India, and, by trading at Alexandria, added to the wealth and importance of Egypt. When Carthage was destroyed, and Corinth was no more in its glory, Egypt increased its means of accumulation, and supplied the whole Mediterranean by its own shipping. Rome became a favoured nation, and while it supplied the increased luxuries of the state from the ports of Egypt, it afforded a source of wealth to the Ptolemaic princes, by its great consumption of the merchandise and luxuries which were brought from India. When the Romans became masters of Egypt, the country continued to flourish in trade; but the Romans, being warriors rather than merchants, were not calculated to promote the commercial prosperity of Egypt.

In the process of time, Egypt was subdued by the Saracens; and the particular circumstances of their empire occasioned an extension of the trade with India. A communication was opened between that country and Constantinople, by means of the rivers Indus and Oxyx, in connection with the Caspian and Euxine Seas. The trade which was formerly carried on through the Persian Gulf and the Euphrates, was afterwards conveyed by Palmyra to the Syrian coast. It was this trade, perhaps, which raised Palmyra to so much splendour, though situated in a desert; and when circumstances occasioned its ruin, the trade of the Persian Gulf was conveyed by Aleppo to Constantinople. Since the discovery of the Cape of Good Hope, the Indian trade with Egypt is considerably diminished; but perhaps it might have been more attended to, if Egypt had not become a province of an overgrown but feeble and degraded empire. It still carries on a trade with India, and the goods are landed at Suez or Cossir, and conveyed from thence to Grand Cairo, and other parts of the country. Various caravans convey passengers and goods from Fez, Tunis, and Algiers, as well as from other parts of Africa; and the caravans, which convey pilgrims to Mecca, are also employed in the merchandize of India and Arabia. If Egypt were under the influence of a well-regulated government, it would become a nation of high importance, both in point of splendour and the arts, as well as in the place of commerce, well fitted to hold communication with all places of the world. In its present circumstances, its trade is much interrupted; but when the Mediterranean is open for commerce, it exports many valuable articles, not only to Constantinople, the coast of Barbary, and other places belonging to the Grand Signior, but also to Venice, Marseilles, and Great Britain. Among these articles may be comprehended Mokah coffee, myrrh, various kinds of gum, cinnamon, with a great variety of drugs, mother-of-pearl, dates, opium, frankincense, and rice; to which may be added, linen clothes, buffalo and ox hides, and camels skins. From the same or similar parts, they receive woollen clothes, both superfine and common; iron and lead, together with various articles of cutlery and sharp-edged tools. Silks are even imported into Egypt of a different kind from what is manufactured among themselves, and printed cottons of showy patterns; to which may be added, tobacco, copper, quicksilver, and, in short, every article of the arts, which the ingenuity of other nations have produced.

The villages of Egypt pay a fixed revenue to the Grand Signior; and the lands were formerly let for life, upon condition of providing annually a certain number of soldiers. These were obliged to arrange themselves under the banners of the provincial governor, who, on that account, was called the Sangiacs, and the number of the troops was varied as circumstances required. Now this undefined manner of providing soldiers is abolished; and the country at large is obliged to supply the Grand Signior annually with 3000 troops, if required. Another branch of revenue to the court of Constantinople is the custom-houses, which are established in various parts of Egypt; and the last source of income is the capitation-tax upon all those resident people who are not Mussulmans, and that tax is called harak. The present situation of Egypt in these respects cannot be explained. It has scarcely recovered itself from the threatening influence which the bey had acquired, and from the shock which was given it by the French invasion. The feeble authority of the Porte over its distant provinces, is not calculated either to make them productive or happy; but we believe Egypt has improved of late, in obedience to the orders of the Grand Signior, and, if well managed, is able to yield a considerable revenue.

The earliest form of government, which we find amongst the Egyptians, was strictly monarchical; and it appears to have been as unlimited as any before or since that time. We are not to enter upon a discussion of the advantages or disadvantages of the various modes of government, which have had their times and their changes among the nations of the world. We believe that in this, as well as in every other respect, extremes are dangerous; and it seems to require no proof;
that the most happy form of government lies between the extreme of absolute power, and that of pure democracy. In a mixed state of privileges and power, where the people check the tendency of the rich and dignified toward increased authority or absolute rule, and where the prince and the nobles restrain the turbulence, and chasen the innovations of popular movements, there is the best chance for moderation of government, and stability of happiness.

In some respects an absolute government is better calculated to raise monuments of national glory. Having the whole powers of the state at his command, the unlimited monarch can bring them more quickly into action, and direct them to bear with greater certainty on any individual point. With a secrecy and expedition which no popular government can obtain, he carries into effect the purposes of his will, though great or difficult. Hence the pyramids, the labyrinth, and other works of great difficulty and labour in Egypt, were accomplished by its absolute kings; but in the performance of these works, the oppression of absolute authority was felt. To procure money for such vast designs, the impostes were grievous, and in some cases, where the necessities of the state were supposed to require it, the feelings of the people were hurt, by having the money allotted for the public services diverted into the channel of common life. In such cases, the labour of the people was excessive; and we know the children of Israel cried by reason of their task-masters, who were severe and unrelenting. A monarch of Egypt boasted, that his slaves and captives only were employed in public labour, and that no native Egyptian had been engaged in works of such toil; but whatever an individual of influence and national delicacy might do in saving his subjects, yet a severer master might employ severer means; and even where bondmen and captives can be cruelly treated, the government is not correct; nor the arrangements such as justice or humanity require.

But, however, the government of Egypt may be said to have been always of an unlimited nature. Through every successive change, it still maintained the character of unrestrained monarchy, till it became a province of the Turkish government; and then it had a divan, at the head of which is a pasha, or deputy-governor, with some appearances of a deliberative council. But this form of government, though apparently allied to a mixed and limited authority, was notwithstanding exposed to very arbitrary exactions. And yet the arrangements were so disjointed and feeble, that the government was neither steady nor secure, for, amid the tumults of an ill-regulated state, the court of Constantinople nearly lost its authority. In this condition, the turbulent and ambitious boys were striving for the supreme command; and since they were subdued, we suspect that the liberties of the people are neither accurately defined nor well secured, so that the government of Egypt is still absolute, and unfriendly to order and happiness.

Egypt was celebrated for wisdom of old, and the learning of that country attracted to its schools the wise and inquiring of other nations. We are to estimate its pre-eminence, not by a comparison with the present state of erudition, but by considering the rank which it then held in the scale of knowledge. India, Babylon, and even Phcenicia, lay claim for no considerable share of literary glory. But the principal competition seems to subsist between India and Egypt. Each of them has its supporters, and it would be presumptuous, as well as unwise, to decide the contest from the nature of the documents which have hitherto been furnished. It is more becoming to say with the poet—

"Non meum inter voce tantas componentes illis."

Yet we may suppose, that both of them flourished about the same period, and that there must have been an intercourse, less or more frequent, between the two nations. If we were disposed to argue strenuously in favour of Egypt, we might say, that there was a period in its early history, when the learned, the wise, and the noble, were compelled to seek refuge in other countries, and many of them might land in India.

The season to which we have an eye, was the time when Cambyses desolated Egypt, destroyed its temples, and overthrew its venerated order of things. For a succession of years, the natives were oppressed; and during such events, it was natural for men of eminence and spirit to leave a country which was unworthy of their presence, and to take refuge in more favoured abodes. It may also be observed, that the madness of Ptolemy Physcon drove from his kingdom many of the wisest and most literary persons; and they, too, might seek and find protection in the East.

Though the system of morals could neither be pure nor accurate, under the circumstances in which Egypt was placed, yet there are many reasons which lead us to suppose, that the great principles of moral conduct were known and inculcated there. The principles of justice appear to have been defined with considerable attention, and the laws of the country fairly dispensed. The duties which were due to one another, were as well regulated as the distributions of rank and influence in an absolute government could allow. But still there were many sentiments and practices which we should condemn; and to shew the untractable nature of the human mind, we have many deficiencies to deplore in the most exalted state of knowledge and virtue.

The Greeks are supposed to have obtained the beginning of their mathematics from Egypt; but if we may form our judgment from what is related of Thales and Pythagoras, we shall not have reason to form a high opinion of their mathematical learning previous to the time of the Ptolemies. In the schools of Alexandria, that science was carried to an eminent height; but the ancient state of learning at Thebes, and other schools of the country, appear to have been confined to a lower sphere. It is told, with some interest, that Thales was taught to measure the height of the pyramids by the length of their shadows; and that Pythagoras offered a hecatombe in devotion, when he discovered the relation which subsists between the hypothesis of a right-angled triangle, and the sides of the figure which contain that angle. Other instances may be added to the same effect; but still it must be acknowledged, that Egypt was eminent in her time, and her philosophers appear to have made considerable progress in the science of astronomy. The overflowing of the Nile was an object of much national importance; and, in connection with it, they observed the heliacal rising of the dog-star, which enabled them to fix the commencement of the year, and make considerable approximations towards ascertaining the length of its duration.

Thales divided the sphere into five zones, and in many respects improved the astronomy of Greece. Pythagoras intimated a belief, that the planets moved about the sun as their centre; and if these philosophers
made further progress in knowledge, than the Egyptians themselves had done, yet still the origin of their requirements may be traced to Egypt. And though the current of science must have been enlarged by tributary streams, yet the spring is to be found in the banks of the Nile. The Egyptians had made some improvements in the art of metallurgy; and the golden calf, made by Aaron in the wilderness, is a monument of his skill. No nation can have advanced far in civilization and the arts of life, without having also cultivated the art of music. Certain tones and inflections of the voice, being agreeable to the ear, are cherished and diversified according to the skill and ingenuity of those who are lovers of harmony. It has always been customary to mingle music with festivals and rejoicings; and though the scanty remains of Egyptian history furnish us with few materials for ascertaining their musical attainments, yet upon the architectural ruins of the most ancient edifices of that country, instruments of music are represented in various states of progress, from the most simple to a highly improved form of the harp; and where music is cultivated, poetry has always been considerably improved.

The arts of surgery and medicine were simple and defective in such ancient times, as those of which we are writing; and in Egypt the inflexible adherence to ancient practices was unfavourable to the progress of the healing art. In the ancient state of Egypt, no remedy was to be applied, nor any application recommended, but such as were approved of in their sacred books. But such restrictions were gradually removed; and in the schools of Alexandria considerable progress was made in medical studies. Yet, even in early times, there were some arrangements, which tended strongly to the perfection of those arts. The medical practice was divided into various departments, and some studied the diseases of the eyes, others the teeth, the ears, and other distinct parts of the human frame. The practice of divination was common in all the ancient countries of the East, and it was even applied to the healing of diseases.

Writing. The Coptic, or ancient language of Egypt, is almost extinct, but perhaps might be found in its purity in the manuscripts remains, which are said to be deposited in the monasteries of that country; and the Arabic is now in considerable use in Egypt, though different languages are spoken by the people of different nations who sojourne there. We have no means of ascertaining to what degree of improvement the Coptic was carried by men of genius in the ancient schools; but to Thoth or Mercury are ascribed the most important improvements of early literature and science in Egypt. Whether by Thoth we are to understand an eminent scholar, who contributed largely to the advancement of knowledge, and by whose name every literary improvement was dignified; or whether by Thoth be intended the general means of knowledge in Egypt, is an inquiry which cannot be satisfied. It is enough to know, that by Thoth, or some adequate persons or means, various advances were made in literary pursuits; and amongst these we may enumerate the art of writing and recording events. Dates and inscriptions were originally cut upon the rocks, and in a more portable manner, though not very commodious, upon stones and bricks. Shepherds and rural nymphs eulogize the names and praises of their lovers upon the barks of trees; leaves, too, were inscribed with verses; and the Papyrus of Egypt was formed and compacted into sheets, and obtained great celebrity, as valuable materials for forming books. To this succeeded parchment, or skins of animals, variously prepared; silks also were employed for the purpose of inscriptions; but the most valuable article hitherto invented, is paper, made of cotton or linen rags.

We cannot enter into the history of alphabetical writing. Like every other simple art, it was the produce of much generalizing, and many experiments. To express sounds by certain symbols, and to combine these into words capable of communicating the whole thoughts and intentions of the heart, could not be a work of rude times, and implies considerable skill and experience. The most natural way of communicating an idea in a state of unlettered simplicity, would be to give signs instead of words, and to draw a picture or representation of the things signified. Hence hieroglyphies, or picture writing, appears to have been the earliest method of entering ideas upon record, or communicating sentiments, without words or bodily signs; for, perhaps, knotted cords, which are still used in some ignorant, and mark the constellations in the Chinese zodiac, may be considered as an additional step of improvement. Picture writing appears to have been common in ancient times. When the Spanish ships, first appeared off the coast of Mexico, an alarm was raised by figures and representations, transmitted to the seat of government; and in the islands of the Pacific Ocean, hieroglyphical writing is universally known.

But in Egypt that species of writing has been more celebrated, because it was carried to a higher pitch of perfection. Before the use of alphabets was known, it was practised in the ancient schools of Thebes and Atonum; and when cultivated as a science, and practised on an extensive scale, it was necessary not only to express simple ideas by a picture representation, but also to communicate abstract notions and various qualities. The simple representation of the eye only expresses that bodily organ, but when shewn in a cloud and seen from above, it denoted the inspection of the Divinity. A serpent wrapped up in circular foldings, and the end not easily seen, denoted the perpetual duration of God. The representation of a figure, with several heads and eyes looking to every quarter, represented his universal observation; and the head of a hawk, with its keen eye, pointed out the penetrating knowledge of God. This leads us to understand why the statues of the ancient gods in Indus have many hands and many heads; and what is to be understood by the figures of monstrous animals, like the sphynx, which nature never formed. They are all connected with hieroglyphical sentiments, and intended to communicate various qualities and dispositions of the mind.

In the same manner, a sceptre was employed to denote power, a lion to give an idea of strength, and a dog of fidelity. These hints are sufficient to shew the nature of hieroglyphical writing; but it must be obvious, that, in the course of its application, it became exceedingly complicated; and the allusions being often arbitrary, they must, in some cases, have been difficult to be understood. In the course of time it fell into disuse, and, excepting the general notion which has been discovered of its nature and tendency, the particular knowledge of the art is lost; and the hieroglyphical writings, though seen distinctly by the eye, are the same to us as a sealed book. Another circumstance which has tended to conceal the meaning of hieroglyphical inscriptions, is the progress which was gradual.
ly made from picture writing to arbitrary marks. The representation of an ear would everywhere imply hearing, and a foot or a hand would denote action; but a mark assumed at pleasure, to signify an object or abstract quality, could only be known, where the original intention and arbitrary assumption was communicated. Most of the hieroglyphics, which are found in Egypt, appear to be allied to this description; and with the knowledge of the arbitrary signs and marks, which were adopted to express ideas, the meaning of the writing itself is forever lost to the world. In connection with these arbitrary signs, the formation of the Chinese language seems to be placed; and from that circumstance, the difficulties which attend the learning of it appear to flow. According to Hager, new dynasties sometimes introduced new characters; and thus the extent and the difficulty of the language were increased. It appears from Staunton’s Embassy to China, (vol. ii. p. 576.) that approximations have been made toward converting the Chinese characters into letters, or elementary sounds, after the manner of alphabetical writing. Whenever this method shall become general, the Chinese language will be as easily acquired as other foreign tongues.

Religion.

Neither having come into the world by our own power, nor being preserved in existence without other resources than our own, it is natural to inquire about the Being who made, and the Providence which preserves us. Even in a rude state, whilst sentiments of an acute or very rational nature are not to be expected, we should deem it impossible for the human mind to be destitute of all those feelings and views which enter into religion; and hence, no nation has ever been found without some ideas, more or less legitimate, concerning the existence and nature of God. Even without the knowledge of our sacred books, we think it impossible, that an unbiased and enlightened mind could imagine, that the Supreme Being would form his rational creatures without an adequate knowledge of spiritual things. Their instincts are in immediate operation; and though their religious views might be comparatively imperfect, yet we may be well assured, that he who takes care of the body would provide also for the mind. The book of Genesis, which is by far the earliest record of ancient things, represents the original state of man as enlightened in the knowledge of God; and the most ancient information which is handed down respecting his religious condition, represents to us the acknowledgment of one pure and supreme cause. Of this there are many indications besides the celebrated inscription at Sais. The first temples, too, were built of unpolished stone, without any image or sculptured figure; and this not only in Egypt, but in other countries.

But a pure and spiritual worship, abstract ideas, and the exclusion of every material object from our view, is a difficult exercise of the mind, and requires a higher tone of exertion than could be easily maintained in more rude and corrupt times. To aid the imagination, and cherish the devotional affections, emblems, or symbols, of the divinity, were admitted into the worship of the Deity. An unformed mass of stone was probably the first memorial of the divine presence; and it is said, that there are African tribes who still worship such massy blocks. Perhaps the large stones which have raised so many conjectures in our own country, may have been objects of worship in the time of the Druids, or at a more early and less informed season. In this state of the human mind, more striking appearances of nature would naturally attract the notice of men, and be viewed as appropriate memorials of the divine perfections. Hence, the sun, the moon, and the stars, held their station in the list of those objects which suggested religious ideas; and we know, that those parts of nature were much and generally worshipped in the East.

Taught to consider everything as coming from the Deity, his presence would naturally be acknowledged in every operation and blessing of nature; and hence the woods and the streams became sacred; vegetables and plants were deified; and, in Egypt, divine honours were paid to some of the brute creation. We can easily see how the hosts of heaven, which commanded admiration, might be objects of divine regard; we can feel how the shady grove, or the deep forest, might excite veneration in a sultry climate; we can figure to ourselves, how a spring of water might raise grateful emotions in a thirsty land; or how copious rivers, like the Nile and the Ganges, might be worshipped, and praised in, as agreeable services to the munificent Author of such delightful streams; but we cannot easily comprehend how the bull and the cow, or such animals as the crocodile, the ichneumon, the cat, and the ibis, could command such reverence and solemn rituals as they did in Egypt.

It is difficult to comprehend how Osiris, whether the representation of a hero or the sun, should be worshipped under the figure of an ox; but we may suppose, that such sacrifices as these were offered for the bountiful supplies of nature, in yielding the means of subsistence, and even the luxuries of life. The cow, and other animals, in one period of the Egyptian history, were common sacrifices; and it may be difficult to shew, how this animal, as well as others, became afterwards so sacred, that to take away their life was the highest crime. It is generally understood, that the earlier race of men subsisted solely on the fruits of the earth, and that the use of animal food was introduced at a much later period. It would appear, that a religious sect had sprung up in Egypt, as well as in India, to counteract this innovation in point of food; and as religious scruples take the most lasting as well as firm hold of the mind, the prohibition to use animal food, would naturally be extended to the taking away of the life of the brute creation, excepting in cases which circumstances, or ascertained forms, would prescribe. It is probably on this account that the Hindoos confine themselves to vegetable food.

The people, in the early improved countries of the East, appear to have had many sentiments and manners, in common; and we presume, that the Egyptians, at one period, had their manners and habits similar to those of Hindostan. Each of them were divided into different castes; both of them venerated the ox and the cow; and the same superstition, with respect to this worship, is found in Thibet. The consecrated bull, which was most venerated in Egypt, was distinguished by many peculiar marks, and of a fine figure. It was called Apis, and was worshipped at Memphis. The other bull was black, was denominated Mucirs, and kept at Heliopolis. These animals were treated with much pomp, and maintained at great expense. Their death was lamented with bitterness, and observed with many marks of public mourning. Various ceremonies were observed in finding a successor; and the consecrated calf was introduced into its situation with much pomp, and certain ceremonies not to be commended.
Osiris was said to represent the sun, and Isis the moon. If the cow and the bull were sacred to Isis and Osiris, the ram was worshipped at Thebes in honour of Jupiter Ammon; and the sheep were considered as sacred animals. Pan was venerated at Mendis by the symbol of a goat. Amnis was painted with a dog's head, and accounted the divinity of sanguine and watchfulness. In short, there were a diversity of divinities under different appearances, and honoured with different sacrifices, but all of them alluding to the bounty and productive qualities of nature. To these we must oppose the worship of Typhon, who was considered as the author of evils and misfortunes. Like the fountain of good, the source of evil was described by different names; and to these beings the crocodile, and other forbidding animals, were devoted. Different cities had peculiar divinities, who were worshipped there, and under whose protection the people were supposed to be placed.

The public festivals were celebrated with exceeding splendour, and vast multitudes assembled to solemnize the rites. The scenes at Juggernaut may give you an idea of some of those Egyptian revels; and there, too, indecent rites were allowed. But the most afflicting scenes which have ever degraded the ceremonies of idol worship, were the human sacrifices, which were frequently offered to appease the wrath of offended divinities. To Typhon were such sacrifices presented; and as the red-haired were chosen for this purpose, and the Egyptians being of a dark complexion, Greeks or strangers were frequently obtained. Perhaps this distinction of colour was made on purpose to save the natives from such a fate. This barbarous custom was continued in Egypt till the reign of Amasis; and it was not till the time of the caliphs, that the peculiar practice was laid aside of sacrificing annually a virgin to the Nile, when a mock ceremony was substituted. Heliopolis and Thebes were peculiarly marked for this dark superstition. Every ancient nation, excepting the Jews, were guilty of such horrors; and still prisoners of war are sacrificed in the South Sea islands, and in some parts of Africa, Asia, and America.

Heroes were worshipped in Egypt, and eminent persons were raised to the rank of gods. At first it was merely veneration for great characters after their death; but it was an easy and natural transition, in a country where the objects of worship were so multifarious, to suffer great respect and high veneration to pass into prescribed forms of divine worship. When the Romans took possession of Egypt, they did not change its religious rites; but Christianity obtained its votaries there, as well as in other parts of the Roman dominions; and when the Saracens subdued it, they imposed upon the inhabitants, as far as possible, the religion of Mohammed. Both Jews and Christians are allowed to reside in Egypt; but the only authorised religion of the country is still the religion of Mohammed.

The ancient temples were large and costly buildings, and, in point of splendour, outshine every other edifice. Various circumstances contributed to give them this pre-emience. The priests of Egypt were the princes of the land, and had great influence over the national revenues. The whole national feeling was favourable to the dignity of the public worship; and the temples, together with the tombs of the illustrious dead, were the principal works upon which they bestowed much labour or expense. To this assertion we must not be understood as making an exception in favour of royal palaces, for it does not appear that any fabric of this nature could bear a comparison, either in point of dignity or extent, to the temple, which were erected in honour of the gods. The holy place, where the sacred animal, the representation, or the statue of their divinity was placed, was comparatively of small extent. At Butas, at Suis, &c. the sanctum sanctorum was of one large stone, brought from the granite quarries of Elephantum. The vast compass of the temple buildings was employed in porticos and vestibles, open courts, curious windings, and private abodes. In connection with the temple itself, were the lodgings, or sumptuous dwellings of the sacred order; and the whole constituted a grand assemblage of various apartments and expensive buildings.

In this respect, an important difference subsisted between the temples of the Greeks and Romans, and those of the Egyptian people. The views and constitutions of Greece and Rome admitted an increasing series of divinities, and a vast profusion of temples was scattered through the various cities and towns of their respective dominions; whereas, in Egypt, though the gods were various, yet their worship appears to have been consistent with each other, excepting the offerings, and sacrifices which were presented to the hateful beings who were supposed to be the authors of evil. Selon, if ever, was there more than one temple in a city of Egypt; because these buildings were erected by the state, and not by the people, who were neither permitted to deliberate nor have a choice in sacred things; and while this appears to intimate, that their divinities were more diversified by names than in reality, it enabled them to render their religious fabrics more spacious and splendid. Through the whole Egyptian constitution of sacred things, there were doctrines and rites which were concealed from the vulgar eye, and held back from uncultivated minds; and, while the multitude were invited to join in the public festivals and duties of religion, certain orders and individuals were only initiated into the mysteries, which it was then thought wise and prudent to conceal from the vulgar. And hence those interior and subterraneous apartments, where these instructions were given, and the secret ceremonies observed. These mysterious places were kept secret, and not exposed to the public eye.

Among the things of a serious and important nature which claim our notice, and mark the character of nations, is the care which is shown toward the dead, and the reverence maintained for the tombs of their friends. In this respect the Egyptians were conspicuous for attention and reverence. We cannot enter upon the consideration of the various methods by which, in different ages of their country, they manifested their attention to the dead; for though the number of bodies preserved in a peculiar manner, and denominated mummies, have led us to suppose, that this was the general mode of disposing of their dead, yet we can scarcely imagine, that through such a length of time as the ancient Egyptian kingdom subsisted, the manner of treating their departed friends was uniformly the same. Other nations have pursued various methods; and, though the ancient Egyptian manners were not given to change, but, by national prejudices, were peculiarly permanent, yet in a long lapse of time, different methods must have been adopted for disposing of their dead. The operations necessary for the formation of mummies, are not consistent with a very rude state of society. They require preparations, and a degree of knowledge, which imply improvements in the arts of life.

Having taken out the brains and bowels, the body
was anointed with oil, and deposited in nitre for a certain time. Then the cavities were filled, and the whole perfumed with aromatic drugs; and, being wrapped up with fillets of many folds, and the face covered, so as to retain its natural shape: the whole was preserved to defend it from the air. In this situation it was put into an open coffin of sycamore wood, or a kind of pasteboard, and carefully painted. Bodies thus prepared were sometimes deposited in the houses of the dead, but more commonly in the vaults of public buildings, or in excavations hewn out of the rock. But neither in Egypt, nor in any other part of the East, do coffins appear to have been much in use of old times, and the mummies which are deposited in open coffins, may either be supposed to have been persons of a superior rank, or they may have been prepared in a later period of the Egyptian history, when changes had been introduced in the manner of preserving the dead.

As a part of the Egyptian code of laws, and a means of promoting virtuous conduct, we are told, that an inquest was held upon the dead; and according to their character, so were the ceremonies of their funeral prescribed. Infamous characters were either not permitted to be buried at all, but as criminal and degraded persons are still, among the ruder nations of the East, cast out into the streets and fields, and left without burial, so among the Egyptians they were denied those sepulchral rites, which were considered as marks of merit and approbation. There was a time in Egypt, when persons, perhaps those of distinction, were buried in the islands of the lake Moeris; and if the profane were not permitted to receive such a testimony of respect, it might give rise to the fable of Charon ferrying the souls of the departed over the Styx and Acheron; and not being permitted to receive into his boat the spirits of those whose bodies had been denied the rites of funeral. The present name of the lake is Charon, and that, in the Coptic language, signifies a ferryman; which gives countenance to the allegorical story which has now been mentioned. If the tomb of Osymandias was really so magnificent as it has been described, and if the pyramids were intended for the burying place of kings, then there is a further appearance, in these stupendous buildings, of the excessive care which the Egyptians manifested about the state and protection of the dead.

The houses which they dwelt in when living, were frail buildings, composed of perishing materials; and even the palaces of kings were inferior in splendour to the temples of the gods; but the receptacles of the dead were more permanent in their nature; and princes as well as potentates, aimed at perpetuity in the places of their rest. And they have not altogether aimed in vain; for the sepulchres and tombs of Egypt are the principal remains of architectural greatness. Though a distinction was made, and that perhaps wisely, between the righteous and the wicked at their death, yet their friends and relations were permitted to remove the disgrace attached to their unburied connections, by certain compliances and forms, which were necessary for having their dead removed from their sight. And, in conformity with this arrangement, their souls might be represented by the poets as wafted by Charon's boat to the place of their final destination, after the rites of sepulture had been performed, or a certain lapse of years had been completed. Who is unacquainted with the feelings which are excited, when beloved friends are removed by death? In every nation, the power of these feelings is expressed in a particular manner; diversified, in part, by attending circumstances, and constitutional temperament; but among the Jews, as well as other nations of the East, all the plaintive passions were uttered with loud lamentation, and sometimes by wounding their bodies, and afflicting themselves cruelly. These severities were continued for a longer or shorter space of time, according to the rank of the deceased; but in every situation the mourning was loud and violent.

The benefits arising from the knowledge of other countries, are not bound by the gratification which it yields; but they open up a field for imitating what is valuable; and have a tendency to make us contented with our own lot, when it is not inferior to the general condition of others. The provision for happiness throughout nature is wise and abundant, but much depends upon knowledge and virtue; and it ought to give us satisfaction, in being so highly favoured as a people. The degraded state of Egypt, should show us the advantage of good laws, and of such means of improvement as enlarge the mind, and promote the welfare of nations. It is our duty to do all in our power to better the condition of others; and it is our interest to improve the benefits we ourselves enjoy, which are every way great and valuable. See Playfair and Pinkerton's Geography. Bruce, Brown, and Park's Travels. Volney, Sonnini, Denon, and Dietion. Univer. de la Geog. Herodot. Renne's Geo. Staeb. and Ptol. Geog. Hager, Staunton, Warburton, Jablonski, Etat de l'Architect. Asial. Research. Norden, and Shaw. (J. W.)
EIGHTH.

507.09152: in the new notation of Farye, it is $507.09152$ or $11f + 49m$ (see Plate XXX. of Vol. II.); it is equal in concordant elements to $3.4ths - III, 16th$: in diatonic elements to $2T + 2s + 3s = 11f + 27c + 20s = 7s + 4s + 2s$.

Some of its others are, 8th $= 2n + 12h = 4th + 5th = VIII - 1, = 7th - II, = 11th + IV, = 12th -- VI, = VIII $= 49c + 26s + 11f$, &c. By tuning upwards from C, three perfect minor fourths, and downwards thereof a perfect major third, this interval is correctly produced on Mr Liston's organ, and is his Cb.

**Eighth Comma-deficient Major, (VIII),** or grave octave ($VIII - C$), or grave major eighth, has the ratio $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 12f + 52m$: its common log is $0.70436503213 \approx 0.704365 \times VIII \approx 54.79762229c \approx 3.4ths - 3rd - I = 2T + 3t + 2s, = 12f + 28c + 21t, = 9s + 29c + 12f$. It is C on Mr Liston's organ, and is tuned above C thus, 4-4ths + IIII + VIII; it is the lesser incominest eighth of some authors.

**Eighth Comma-deficient Minor, (8'),** or grave minor eighth, ($8 - C$), the apto-fifteenth eighth ($VIII - P$), and deficient lesser flat eighth, &c. of different writers. Its ratio is $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 11f + 48m$: its common log is $0.7248878,3537 \approx 0.724887 \times VIII \approx 50.31511022c \approx 5.4ths - 2III - 5ths, = T + 5t + 3s, = 11f + 26c + 19s = 48c + 26s + 11f$, it is C'b of Liston's scale, and may be tuned above C, either by 7-4ths + 2VIII, or 5-4ths + 2V.

**Eighth Comma-redundant Major, (VIII),** acute eighth, or redundant eighth of some authors, has the ratio $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 11f + 54m$: its common log is $0.6935749,7245 \approx 0.693575 \times VIII \approx 56.79762229c \approx VIII + C = 8.3d + 2III - 4th, = 4T + 1 + 2s; = 12f + 20c + 28s = 54c + 29s + 12f = 7th + T$. It is C on Mr Liston's organ, and may be tuned above C thus, 2V + 3d + 4th: it is the greater incominest eighth of some authors.

**Eighth Defective of Holden,** is an interval not belonging to the diatonic system, because involving the prime integer 7; its ratio being $\frac{21}{22} = \frac{21}{22} = 0.982607066 + 11f + 51m$: its common log is $0.7058094.2887$. It is $507.09152$.

**Eighth Diminished-major, (VIII - C),** called by some writers the Greater Flat Eighth, the Comma-redundant Minor Eighth, ($8 + C$), the Imperfect Diapason, and by Liston the Acute Minor Eighth ($8'$), &c. is an interval whose ratio is $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 11f + 50m$: its common log is $0.7190191,7310 \approx 0.719019 \times VIII \approx 56.79762229c \approx VIII + C = 8.3d + 2III - 4th, = 3T + 4t + 1 + 2s; = 12f + 20c + 28s = 54c + 29s + 12f = 3th + T$. It is C on Mr Liston's organ, and may be tuned above C thus, 2V + 3d + 4th: it is the greater incominest eighth of some authors.

**Eighth Diminished of Liston (8 - C),** or diminished minor eighth, has a ratio $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 10f + 46m$: its common log is $0.7398225,7015 = 0.8644292, = 48.22558 \times c, = 3d + 5-th = 7III, = 2T + t + 4s = 10f + 26c + 19s = 46c + 23s + 10f = 7 + 5$: it may be tuned thus, 6th + 2-4th - IIII, on Mr Liston's organ.

**Eighth Double-deficient, (VIII - 2c),** is an interval whose ratio is $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 5f + 12f$: its common log is $0.7097500,6812 \approx 0.709750 \times VIII \approx 53.79762229c \approx 5-4ths - III - 3-3ds, = T + 4t + 2s, = 12f + 27c + 20s, = 51c + 29s + 12f = 3T + 2t + 2L$: on an organ with a sufficient number of pipes, like Mr Liston's, it may be tuned thus, 5-4ths - V - 2-3ds.

**Eighth Double Superfluous, (VIII + 2c),** is an interval whose ratio is $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 12f + 55m$: its common log is $0.6881793,4057 \approx 0.688179 \times VIII \approx 57.79762229c \approx 5-5ds - IIII - 3-4ths, = 5T + 2S, = 12f + 31c + 24s, = 53c + 29s + 12f = 7T + 2t + 2S$: on Mr Liston's organ it may be tuned thus, 3V + 2-3ds - 5-4ths.

**Eighth Minor Comma Defective, (VIII - C),** or the double tritone (2 IV), is an interval whose ratio is $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 12f + 52m$: its common log is $0.7088749,2909 \approx 0.708875 \times VIII \approx 54.88888888c \approx 2-3d + 4-11$ = 11 - 4ths = 3-4ths = 7T + 3s + 1, = 13f + 80c + 232s, = 56c + 32s + 13f = VIII + T, = VII + 11, = 9th + E, = IX - F. On Mr Liston's organ it is e's, and may be tuned thus, VI + III.

**Eighth Superfluous of Bohetrieder, (VIII + P),** apto-fifteenth eighth, or the superfluous diapason of some writers. Its ratio is $\frac{63}{64} \times \frac{64}{65} = 0.9998 + 12f + 55m$: its common log is $0.684511,7361 \approx 0.684511 \times VIII \approx 59.078777,765 \approx 59.0787 \times VIII \approx 61.0887777,205 \approx 61.0887777,205 \approx 59.0787777,205 \approx 61.0887777,205 \approx 61.0887777,205$. It is C on Mr Liston's organ, and may be tuned thereof thus, 4V + 2-11 = 2-3ds.

**Eighth (supposed) of Mersennus,** this author, from an erroneous calculation, concluded the octave to be equal to 58: which was not the major comus: but which is $0.58396 \times 181532 \approx 12f + 55m$, and its common log is $0.685739,9260$. (s).
EISENACH, the Irenacum of the ancients, is a town of Germany, in the duchy of Saxe Weimar, and formerly the chief town of the principality of Saxe Eisenach. The town is situated in an agreeable and fertile valley on the river Nesse, and was founded in the year 1070. The streets are regular, and are well paved and lighted, and the town contains several good houses. The principal objects of curiosity at Eisenach are the ancient castle of Wartburg, in which Luther was confined, in 1521. It is situated about two miles from the town, on the top of a high mountain, and is now in a state of ruin. It is nearly an hour's walk from the town to the top of the mountain, and the highest part of the road is cut through the rock. The walls, the ceiling, several ornaments, and the ancient hall of the chancellors, are now filled with hay. The signal tower, the subterraneous prisons, the chambers inhabited by the ancient landgraves of Thuringia, and the chapel of the pious Elizabeth, are still shown. The view from the castle is very fine and extensive. Among the surrounding rocks, there are two remarkable for their elevation and their form. The English garden belonging to M. Reese is upon the heights which surround Wartburg, and is well worthy of being visited. There is a very large and good library, belonging to the grammar school, which was founded in 1707, by the Duke John William. There is also a college, a seminary for divinity, and an orphan hospital. Eisenach carries on a very active commerce, and possesses manufactures of white lead, serges, shags, ribbons and starch. The population of the town is between 8000 and 10,000. For a particular account of the castle of Wartburg, see the second edition of the description of it published by M. Thun: East Long. by astronomical observations, 10° 20' 15", North Lat. 50° 55' 55". (w)

EISLEBEN, or Isselben, is the name of an ancient town of Saxony, and capital of the district of Mansfeld. It is situated on a hill near a small stream called Kleppenbach. The town is divided into the old and new. The old town, which was a flourishing city so early as 1024, has three parish churches, a grammar school, an ancient castle, and 700 houses. The town consists of one parish, and about 300 houses. The church of St. Andre contains several curious monuments. The pulpit of Luther is still shown, but it is used only three times a year, on public occasions. The church of St. Peter, the institution of M. de Burgsdorf, and the Hotel de Ville, with its roof of copper, are the other objects worthy of notice. The house in which Luther was born has been used, since 1772, for the public school. The mantle and the hat of the reformer are still shown to strangers. There are mines of copper in the neighbourhood. The people are principally employed in agriculture, and in the manufacture of salt and potash. About two leagues from Eisleben is a saltwater lake, and, from the top of a small hill, formerly a Trajan pagan tomb, there is a fine view of the two lakes. Population about 6000. See Kurze Nachricht von Luther's Haus, &c, vom Rector Hopf ner, Eisleben, 1790, 8vo. East Long. 11° 44', and North Lat. 51° 40' (w).

EISTEDDFOD, the name given to the annual congress of the British bards, which was formerly held under the sanction of the Welsh princes, at one of the royal residences of Aberfraw, Mathraval, or Caerwyw. See Evans' Tour in Wales, and the articles Bard and Wales.

EKEBERGIA, a genus of plants of the class Dendrid, and order Monogynia. See Botany, p. 211.

ELAGNUS, a genus of plants of the class Te trandra, and order Monogynia. See Botany, p. 126.

ELCHARUS, a genus of plants of the class Pol yandra, and order Monogynia. See Botany, p. 296.

ELAIS, a genus of plants of the class Diocia, and order Hexandra. See Botany, p. 319.

ELASTICITY. See Mechanics, Physics, and Pneumatics.

ELATE, a genus of plants of the class Monocia, and order Hexandra. See Botany, p. 225.

ELATERIUM, a genus of plants of the class Monocia, and order Monandria. See Botany, p. 319.

ELATINE, a genus of plants of the class Octandria, and order Tetragna. See Botany, p. 205.

ELBA, an island in the Mediterranean Sea. It is situated off the Tuscan coast in Italy, from which it is separated by the channel of Piombino—this channel being about ten miles broad in the narrowest part. Its form is extremely irregular. In circumference it may measure nearly seventy English miles. It is mountainous in its general aspect. The plains and valleys which it contains are of small extent. It is surrounded with a salubrious climate, a good soil, and numerous springs of excellent water. Its vegetable produce consists of natural grass, corn, vines, olives, chestnuts, almonds, figs, walnuts, oaks, myrtles, and a great variety of aromatic and evergreen plants. Pears, also, apples, cherries, peaches, and prunes are produced; but they are wild and insipid. Lemons, pomegranates, and oranges thrive here, though not in great perfection. There is a great want of forest trees or large wood. Kitchen herbs are almost entirely neglected. The husbandry of the island is conducted in a most skilful and slovenly manner; so that the crops of corn do not supply the inhabitants with more than three months consumption. The vintage, however, is more than sufficient. It takes place in September. The grapes are of an excellent quality. Two kinds of wine are made from them; red and white. The white is the common wine that is consumed in the island, and is seldom or never exported. The red is made in small quantity, but is extremely delicious. Two sorts of desert wine are produced, viz. Vermont and Cileatico, both of which are of an exquisite flavour, and highly esteemed. In Elba, as in the other parts of Italy, the use of the press is unknown in the manufacture of wine.

Elba has been long celebrated for its iron. Virgil calls it, "Insula, inequumus chalybum generosa metallica." There are several mines of this metal throughout the island; but the principal one, and the only one that is now worked, is that of Rio near the village of Marina, on the eastern coast. It consists of an entire mountain, which is about three miles in circumference, and so abundant as to afford a supply to Corsica, Genoa, Naples, Tuscany, Romagna, and Piombino. About 1250 quintals are sold annually, each quintal consisting of 83,333 lb. of siena. There are daily employed in exporting it to the neighbouring coasts 120 Elbese vessels of from 40 to 100 tons. The price is various according to the quality of the ore: it generally runs from 50 to 52 scudi per quintal. It is an established rule, that the Corsicans have the first choice; and that the Duke of Tuscany is allowed the best parts of the ore called ferrata, for which, however, he pays an extra price. The ferrata is so called on account of its metallic appearance. Its cavities are filled with those crystals, about which chemists have written so much. The other ore to which any importance is attached is micaceous, not so rich as the ferrata, and is
called *lucella*, from the shining of the little scales of which it is composed. Mines of copper, also, exist in Elba, but these are not open. The opinion that the island produces gold, silver, and lead, has been common, but Thiebaut de Bernanoud maintains that it is a mistake. There are quarries of loadstone, granite, and marble, both white and mixed. We meet also with alabaster, steatite, asbestos, serpentine, rocks of quartz, yenite, and various other minerals.

There are few oxen or cows on this island; there are asses, and mules and horses, and a considerable number of sheep, goats, and pigs; but the breed of all of these animals is small, and of some of them, particularly the horse, it is miserably bad. Hares, red-legged partridges, quails, wood-pigeons, rabbits, &c. are found in abundance. The fields swarm with noxious reptiles, such as the smaller scorpion, the blind worm, the adder, asps and vipers. There is also the spotted spider, whose bite is said to be mortal. All the insects common to Italy are found here. There are few bees, and no silk-worms, though the situation is remarkably favourable for both. There are two tunny fisheries on the coast of Elba. One of them is carried on at Porto Ferrajo, the other at Marciana. That at Porto Ferrajo was established first, but that at Marciana is more productive by two-thirds. The annual value of both is estimated at L. 2500 sterling. Sword-fish, dog-fish, dolphins, and sea-calfes, are sometimes killed. There are also found the sole, the bearded mullet, and that brilliant fish called by the Italians *dazzelina*. Formerly the coast abounded with oysters, some of them containing pearls of considerable size and fine colour, but the greediness of the people exhausted the beds, and various circumstances have contributed to prevent them from being again replenished. There are numerous marshes in the vicinity of Porto Ferrajo and Lungone, from which a considerable quantity of salt is manufactured. These marshes are accounted more detrimental to the public health, than they are advantageous to the public prosperity. The manufacture itself is conducted with no skill. Sixty thousand sacks, containing about 150 lib. each, are produced annually. The magazines erected for the reception of the article are said to be fine and commodious buildings. There is no machinery in the island, except that of corn mills, and these are ill constructed, and unskilfully managed. The importations of the island consist of grain, cheese, cattle, and other necessary articles; the exportations of iron ore, granite, vinegar, wines, tunny, and salt. The principal places in Elba are Porto Ferrajo, containing about 30,000 inhabitants, and situated in East Long. 10° 19′ 35′′, and North Lat. 42° 49′ 6′′; Rio, about 2000; Port Lungone, about 1500; and Marciana, about 1200.

In 1808, the whole population of the island was estimated at nearly 12,000. It appears from a calculation, that the average of births is one in twelve, and that of deaths, one in twenty three. The character of the Elboise is very superior to that of the Italians in general. They are extremely attached to their country,—industrious as labourers, and brave as soldiers; simple in their attire, and frugal in their mode of living; not very fond of amusements, and rather grave than lively in their disposition; ignorant and credulous; more superstitious than fanatical; somewhat addicted to flattery; not malicious or revengeful, but irritable and impatient of contradiction. The men are of a robust constitution, live to a great age, and enjoy good health. The women are in general not beautiful. Before marriage they are chaste, though possessed of much sensibility; after marriage, they are remarkable for being faithful wives and affectionate mothers.

The political state of Elba has undergone many revolutions. But the most remarkable event that has ever happened to the island, is that of its being assigned to Napoleon Bonaparte as his sole dominion and retreat for life; so that the Elboise are now the only subjects of a man who, but a few years ago, commanded the destinies of Europe; and who might still have maintained that lofty eminence, had not his ambition grown so extravagant as to render his talents useless, and his oppressions so intolerable, as to unite against him all the wisdom and virtue of the world. Perhaps it was impossible to dispose of this extraordinary personage in a better manner; but it is not impertinent to ask, if he be really the remorseless tyrant which he is universally believed to be, of what crime had the inhabitants of Elba been guilty, that they should be doomed to groan beneath his rod? However, since it was agreed that he should retain his life and his liberty, it was merely expedient that his power of doing mischief should be circumscribed within narrow bounds; and probably no place could answer this view so well as that little island, in which the virtue of the people may either teach him to respect while he rules them, or deprive him of his last sceptre, if he shall employ it for their oppression. See *Voyage to the Isle of Elba*, &c. by Arsene Thiebaut de Bernanoud. *Tour through the Island of Elba*, by Sir Richard Colt Hoare, Bart. &c. (c)

**ELBE**, the Albis of the ancients, and the Labe of the Bohemians, is one of the principal rivers in Germany. It takes its rise near the source of the Oder and the Vistula, in that part of the Carpathian mountains, which is called Riesengebirge, or the Mountain of the Giants. In its course through Bohemia, it receives several tributary streams, but particularly the river Moldau, above Melnik. At Leutmeritz, above which it receives the Eger from Saxony, it begins to be navigable for small boats. After leaving Bohemia, at a narrow pass at Winterberg, near Schandau, which Werner conceives to have been the outlet of a great lake, covering the whole of Bohemia, it enters Saxony, passes by Dresden, and receives the Milde, not far from Dessau. After receiving the Saale above Barby, and the Hevel near Hevelberg, which form a communication with the Oder, by means of the Spree, through Berlin, it pursues its way through the confines of the dukedoms of Lauenburg and Mecklenburg Schwerin, where it receives the Ilmenau. It then advances to Hamburg, where its branches form several islands. It receives the Stor below Glückstadt, and at the distance of 100 miles from this it throws itself into the North Sea, not far from Heligoland.

The navigation of the Elbe up to Hamburg is extremely difficult, on account of its numerous sand banks. When a violent wind blows from the west, in autumn, the waters are swelled to such a degree, that all the canals of Hamburg overflow their banks, fill the cellars and magazines with water, and often inundate the streets. An east wind produces an opposite effect. It drives the waters of the Elbe towards the sea, with so much force, that the canals are left dry, and passengers cross them on foot.

The Elbe is navigable for large vessels up to Hamburg, and for small craft for several hundred miles, and form the principal channel of communication with the whole north of Germany.
The free navigation of the river, however, is greatly injured by an excessive number of tolls and restrictions, imposed by the sovereigns of the different territories through which it flows. Merchandise sent from Pisa, in Saxony, was obliged to pay 32 tolls before it reached Hamburg, and at Magdeburg all vessels not under Prussian colours, or carrying Prussian produce, were compelled to unload, and ship their goods in Prussian vessels, of which 500 were employed by Magdeburg alone. Each prince too insists on payment in the coin of his territory, and the officers, when certificates of payment are granted, are often at a great distance from the water side. Were these inconveniences removed, a voyage on the Elbe would be both expeditious and agreeable, as the passage boats are so constructed, that travellers, on taking beds with them, may regularly sleep on board, and escape the risk of bad inns.

In the year 1796, there were no fewer than 460 vessels employed in the navigation of the Elbe, from Hamburg to Magdeburg. See Bohemia for a particular account of the progress of the Elbe through that kingdom; also Hamburg and Magdeburg. See also Oddy's European Commerce, and Cattaneo's Voyage en Allemagne, &c. vol. i. Paris, 1810. (w)

ELBING, a town of Prussia, in the circle of Marienburg, is situated in a fertile district on the river Elbing, near the Frische Haff. This town appears to have been founded by a colony from Lubeck in 1239, and till the end of the 16th century was included in the Hanseatic League. The demolition of the fortifications, at the cession of the town to Prussia by Poland in 1770, has enriched the town with a grand place. Since the year 1772, Elbing has risen in importance as a commercial town on an island formed by the river Elbing and a moat, a custom-house and excellent warehouses have been erected, those for corn holding no less than 30,000 lasts. About the end of the year 1806, the shipping consisted of 7110 tons, besides 50 coasters, and 25 lighters, which are employed in conveying cargoes to Pillau, 50 miles distant; as ships of 100 tons only can come up to Elbing. Cattaneo, in his Tableau de la Mer Baltique, states the number of vessels that arrived annually at Elbing to be between 300 and 400, the same number clearing out annually.

The exports and imports of Elbing are nearly the same as those of Königsberg, and consisted of iron, ironstone, alum, lead, Brazil wood, coffee, oranges and citrons, indigo, vitriol, rice, tobacco, sugar, soda, and French wines. This trade, however, has suffered greatly during the last disastrous wars, but now that peace is established, it may soon be expected to recover its former importance.

A number of vessels are built at Elbing; and there are manufactories of soap, tobacco, wood-ashes, starch, sailcloth and cordage, besides a sugar-house, and a saw-mill.

The library of the college contains some curiosities; and in the environs of the town, viz. at Geiszels, Thumberg, Haff, and Vogelsang, there are some very picturesque lakes. Population in 1802, 18,400. East longitude 1° 22', north latitude 54° 8' 20" by trigonometrical observations. See Oddy's European Commerce; and Cattaneo's Tableau de la Mer Baltique, vol. ii. p. 903. (w)

ELCHE, the Illíci of the Romans, is a town of Spain in the province of Valencia, situated in a plain almost entirely covered with palms. It contains several good streets, several spacious squares, some splendid houses, and six fountains, one of which is of marble in the shape of a tomb, and discharges excellent water by 20 pipes. At the end of a beautiful bridge, without any water under it, is a circular marble fountain which discharges the water by eight pipes; but the water of this and the other four fountains is brackish. There are three parish churches in the town, an hospital with 20 beds, two convents of monks, and one of nuns. The church of St Maria has a marble portal, and, according to Laborde, is a "monstrous assemblage of plain, twisted, and spiral fluted columns." On the road from Orihuela, on the left as we approach the town, there is a large and handsome square building, which is used as barracks for the troops. The Ducal Palace, standing on the bank of a deep ravine, bears marks of a high antiquity.

Elche carries on a great trade in dates and palms, with which the surrounding country is covered. There are several tanneries and a soap manufactory in the town.

The town is the residence of a vicar-general of the Bishop of Orihuela, and is governed by an alcalde major, four regidors, and some deputies of the commons.

The town is remarkably gloomy, and has no kind of amusement, society being very rare. The inhabitants, and particularly the husbandmen, are rich. Don George Juan, one of the most celebrated of the Spanish mathematicians, was born at Elche. Population 2700 houses, 15,000 inhabitants, of whom there are 500 families of labourers, and several noble families. See Laborde's View of Spain, and Townsend's Travels, vol. iii.

ELDEN HOLE. See Derbyshire.

ELECTION LAWS, in Scottish jurisprudence, are those regulations and enactments, which have been made with the view of preserving the purity of parliamentary representation. We shall have occasion to enter into a more general discussion of this subject in a future article; at present we shall merely give a short summary of the rules applicable to elections in Scotland.

Anciently the parliament of Scotland consisted of the clergy and barons; which last title comprehended every man who held immediately of the king, however small his property. The obligation of attendance on parliament was felt as a burden by the lesser barons in those times; and certain exemptions were sanctioned by the act 1427, c. 101, and subsequently by that of 1587, c. 114. But, at a later period, the feelings of proprietors changed with the spirit of the times, and political rights came to be considered as a valuable privilege, rather than as an oppressive hardship. Hence it became necessary to fix, with more precision, the nature and extent of the elector's title. By the acts 1661, c. 35, and 1681, c. 21, it was provided, that an elector should have, in property or superiority, a forty-shilling land of old extent, held of the king or prince; or when the old extent did not appear, that the lands should be liable in public burdens for L. 400 of value rent. By the latter of these enactments, a regular roll of the freetholders is directed to be made up, and annually revised at the Michaelmas head courts in the different counties. By the act 1680, c. 2, the clergy were finally deprived of the privilege of sitting in parliament. By the union of the two kingdoms (1st of May 1707) the Scottish Parliament was absorbed in the Parliament of Great Britain; the Scottish nobility, instead of their hereditary seats, were now to be represented by 15 of their number, and the proportion of the representation in the House of Com-
ELECTION LAWS.

mons, alloted to Scotland, was 45 members, 30 from the counties, and 15 from the royal boroughs. These representatives are chosen in the following manner.

1. Election of the Peers of Scotland.

The 16 peers of Scotland are chosen from among the members of the ancient Scottish Peerage, who are declared to be the body of electors. When a new parliament is summoned, the peers of Scotland are called by proclamation to meet and elect their representatives. This proclamation must be made at Edinburgh, and in the other county towns, 25 days at least before the day of election. The election is held in the palace of Holyroodhouse; and the meeting is attended by the Lord Clerk Register, or two of the principal clerks of session.

After prayers, by one of the king's chaplains, the proclamation and election are read, the roll called, those present marked, and the signed lists and proxies entered in the minutes. The peers present must then take the oaths of allegiance and abjuration, the oath of supremacy, and the test, and those voting by proxy, or by signed lists, must, if in Scotland, have taken these oaths before the Sheriff-depute in court, certified by the subscription and seal of the judge. If in England, the oaths must be taken in the Court of Chancery, King's Bench, Common Pleas, or Exchequer, and certified by writ under the seal of Court. If the Peer be out of the kingdom, it will be sufficient if it be certified that he has formerly taken the oaths in any of these ways; or that he has taken the oaths in Parliament, certified under the great seal. No peer under age, Roman Catholic, or who declines to subscribe the formula, can either vote or be elected. None can be received as a proxy but a peer, who is himself qualified to vote at the election; and the same person cannot act as proxy for more than two peers. The proxies and lists must be signed by the peer, by his Scottish title alone, in the presence of witnesses, who must likewise subscribe.

After the oaths have been administered to those present, and the oaths of the absent examined; the votes are then counted, the lists investigated, and the peers chosen by a majority of votes declared. There is no casting vote allowed in the case of an equality; but the returning officer states the fact, leaving it to the House of Peers to give their directions with regard to the point. A certificate of the names of the 16 peers being made out upon parchment, is signed and read to the meeting by the officiating clerk, and by him returned to Chancery, in a packet addressed to the clerk to the crown, before the period fixed for the meeting of parliament.

The peers have no right to decide upon a disputed title; but any peer may enter a protest against any of the proceedings which he considers objectionable. Such protests must be admitted by the returning officer, and he must give out extracts of them to any of the peers demanding them; but he takes no notice of these protests in the certificate of election.

2. Election of Commissioners for Shires.

The act 1681 provided, that the qualification of a freethearer should be a forty-shilling land of old extent or property rated at £400 Scots of valued rent. The valuation in the cess books is instructed by a certificate under the hands of two of the commissioners of supply for the county, and of the clerk of supply.

The lands, in order to afford a qualification, must be held of the king or prince; and the claimant must have been infert, and his infertment recorded; or his charter expedite, a year before the enrolment; excepting the case of a husband claiming to vote on his wife's titles, and that of an apparent heir in possession under the infertments of his ancestors; in which cases, the requisite of infertment is dispensed with. The claimant must be in possession of the lands, either naturally, by labouring the ground,—or civilly, by drawing the rents or feu-duties, or even by taking steps for enforcing payment of them.

Minors and featurous persons are disqualified from voting, as also aliens, and the eldest sons of peers. Judges of the Court of Session, Justiciary, or Exchequer, are exempted, as are also the clergy. A person who already represents one county, cannot be chosen to represent another. All persons are disqualified from voting at elections, who are concerned in the management of any duties or taxes (the Commissioners of the Treasury excepted), all commissioners of prizes, sick or wounded, transports, wine-licences, navy and Victualling-offices, secretaries or receivers of prizes, comptrollers of the army accounts, agents for regiments, governors of plantations, and their deputies, officers of Minorca and Gibraltar, officers of the excise and customs, clerks and deputies in the several offices of the treasury, exchequer, navy, Victualling, admiralty, pay of the army or navy, secretaries of state, salt, stamps, appeals, wine-licences, hackney-coaches, hawkers and pedlars, and every person who holds any new office under the crown, erected since 1705. All persons holding contracts with government are incapable of being elected; as are likewise all persons holding pensions from the crown; and, even after being elected, any member who accepts of an office of profit under the crown, excepting commissions in the army and navy, must vacate his seat, though he may be re-elected.

A person claiming to be enrolled, must leave a copy of his claim with the sheriff-clerk, two calendar months before the Michaelmas head-court. The sheriff-clerk must indorse on the claim the date of receiving it, and give out copies of it, when required, for the same fee with an ordinary extract. The copy left with the sheriff-clerk, however, need not be signed by the claimant; even the principal claim need not be signed, nor is it necessary for the claimant to appear in person at the meeting; any of the other freethearers may appear for him; and the possession of his titles, which must be produced, will be equivalent to a mandate. An objection to a freethearer's remaining on the roll, must also be left with the sheriff-clerk two calendar months before the meeting, and indorsed, &c. in the same manner as a claim for enrolment. A claim, or objection, must be supported by one freethearer at the meeting, otherwise the sheriff-clerk is under no obligation to bring it forward.

A meeting of freethearers is not entitled to review the proceedings of a former meeting; but a claimant who has been rejected by a former meeting, may be admitted by a subsequent one, on presenting a new claim. When a meeting of freethearers has done wrong, by rejecting a claim, or by striking a person off the roll, a complaint lies to the Court of Session; which must be
The duties incumbent on persons acting at elections in any official capacity, are enforced by heavy fines. The member who presides in the election of presses and clerk must call the roll regularly, under a penalty of £500; the minutes of this nomination must be made up, and delivered under a penalty of £100; the clerk of the election must make his return to the sheriff-clerk, under a penalty of £500; and the clerk of the crown-office must perform his duty under a like penalty.

2. Election of Commissioners for Royal Boroughs.

Of the 55 commoners by whom Scotland is represented in parliament, 15 are chosen by the boroughs, one by Edinburgh, and one by each of the other 14 districts of royal boroughs.

The following is a list of the 14 districts of royal boroughs, in the order of their precedence:

17. Whithorn. Campbell.

When an election is to take place, each royal borough in the district chooses a commissioner, or delegate, who meet and choose the representative for the district. At the meeting of the commissioners for choosing a representative, the commissioners from the several boroughs in the district preside in their respective turns, and have a casting vote in the case of an equality. Any person, whether a burgess or not, may be chosen as a delegate, to whom a commission is drawn up by the clerk of the borough, authenticated with the common seal. The delegates from the different boroughs meet at the presiding borough thirty days after the issue of the writ, and have a casting vote in the case of an equality. Any person, whether a burgess or not, may be chosen as a delegate, to whom a commission is drawn up by the clerk of the borough, authenticated with the common seal. The delegates from the different boroughs meet at the presiding borough thirty days after the issue of the writ, and have a casting vote in the case of an equality. Any person, whether a burgess or not, may be chosen as a delegate, to whom a commission is drawn up by the clerk of the borough, authenticated with the common seal.
ELECTRICITY.

Definition. Electricity, from the Greek word ἀέρας, amber, properly signifies the science which treats of the phenomena of attraction and repulsion, produced by the friction of amber. As similar and analogous appearances, however, were afterwards observed during the friction of sealing-wax, glass, and a vast number of other bodies, and were developed by various other means, and under various circumstances, the term Electricity has been extended to embrace the numerous and diversified phenomena which appear to have the same origin as those of excited amber or glass. As we are not yet entitled to include the Galvanic phenomena as a branch of electricity, we shall reserve for the article Galvanism, the consideration of that interesting subject.

In the present treatise, we propose to give a full and popular view of the various steps by which electricity has advanced to its present importance among the sciences; to describe the numerous phenomena which it comprehends; to explain the various theories which have been brought forward to account for them; and to describe the most improved machines and instruments which have been employed in advancing the progress of the science, in exhibiting its splendid phenomena, or in applying its tremendous energy to the useful purposes of life.

We shall, therefore, divide the article into three parts. I. DESCRIPTIVE ELECTRICITY, or an account of all electrical phenomena, whether they are produced by natural or artificial means; II. PRACTICAL ELECTRICITY, or a description of electrical instruments, and the method of constructing and using them; and III. THEORETICAL ELECTRICITY, or an account of the various theories which have been proposed to explain the phenomena.

HISTORY.

The property exhibited by amber in attracting light bodies seems to have been known in the very infancy of philosophy; and Thales of Miletus, the founder of the Ionian school, endeavoured to explain this remarkable effect, by ascribing to this fossil the functions of an animated being.

The attractive power of amber was afterwards noticed by Theophrastus, who describes amber, and the Lyonsion, (supposed to be the Tournatine,) as possessing the same property of attracting light bodies (ἐνυπερισσότερον ἀκριβείας;) and he remarks, on the authority of Diocles, that they attracted not only straws and small pieces of wood, but also thin pieces of copper and iron. The Geoponic Economies, amber is said to possess the appearance of restraint on the freedom of election, it is enacted, that all soldiers quartered in any city, borough, &c., excepting the royal residence and garrisons, must, when an election is to take place, be removed to the distance of two miles one day at least before the day of election, and shall not approach nearer until the day after the election. See the several treaties of Mr. Wight and Mr. Bell on the election laws; and the article PARLIAMENT in this work. (2)

ELECTION LAWS.

The oaths to government, and against bribery, and proceed to elect the representative. Minutes of the proceedings are prepared and signed by the preses and clerk. The latter must return the person elected to the sheriff, under the penalty of £500, and six months imprisonment; and the sheriff subjoins the return to the writ, and transmits both to the clerk of the crown.

Bribery, when it can be discovered in a candidate, vacates his election. With the view of removing every

Several detached but unsatisfactory notices respecting amber occur in the writings of Pliny; but the ancients seem to have been acquainted with nothing more than the meagre fact which was known in the time of Thales.

Although the electrical property of amber was noticed by several modern writers, such as Cassendi, Kedeligs, and Sir Thomas Brown, yet no experiments seem to have been made upon the subject till the time of Dr. Gilbert of Colchester. This eminent philosopher, whose name will appear with still greater splendour in the History of Magnetism, may be justly regarded as the founder of the science of electricity. He discovered that the power of attracting light substances was possessed by many other bodies besides amber, particularly by

Diamond, Beryl, Mastic,
Sapphire, Crystal, Sealing-wax, made,
Carbuncle, Glass, of gum lac,
Iris, Glass of antimony, Hard rosin,
Amethyst, Sparry substances, Sal Gem,
Opal, Beleninites, Talc,
Vincetina, Sulphur, Alum.
Bristol stone.

These various substances attracted not only light bodies, but also metals, wood, stones, earth, water, oil, thick smoke, and all solids and fluids, with the exception of air, flame, ignited bodies, and matter extremely rare. The substances were in general suspended in long and thin pieces, so as to move freely about their centres, and the electrical bodies, when excited by a light and quick friction was presented to one of their extremities. With a large and smooth piece of amber, he was able to attract substances without any previous excitation. After having thus determined the substances which were capable of affording electrical phenomena, Dr. Gilbert endeavoured to observe what circumstances were most favourable to their production. When the wind was in the north and east, and when the air was dry, the attractive power was exhibited in about ten minutes after the friction commenced; but when the air was charged with moisture, and the wind blew from the south, the electric energy was most materially impaired, and in some cases almost entirely extinguished. When the body was excited, the attractive virtue was greatly encreased by breathing upon the body, or by sprinkling it with brandy or alcohol, and was wholly obstructed by the interposition of several substances.


The virtues of the ancients has been supposed by some authors, to be dead. Beckmann has controverted this opinion, without being able to substitute any thing precise in its place. He supposes it to have been a sweet-smelling plant, called by later writers basilicum. See Hist. of Intellect. vol. ii. p. 240.
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He also remarks, that glass, talle, and crystal, and all other electrical bodies, lost their faculty of attraction after being burned or roasted. Even in this early stage of discovery, Dr Gilbert could not refrain from generalising the few observations which he had made. He conceived that electrical attraction was similar to the attraction of cohesion, and that it was occasioned by the effluvium of the electric body being excited by friction.

Other hypotheses were about this time proposed, to explain the phenomena of electric attraction. The Jesuit Cabeus supposed that the streams which issue from amber, when heated by rubbing, "discuss and expel the neighbouring air;" which, after it has been driven off a little way, makes, as it were, a small whirlwind, because of the resistance it finds from the remoter air, which has not been wrought on by the electrical steams; and that these shrinking back swiftly enough to the amber, do, in their returns, bring along with them such light bodies as they meet with in the way."

According to the hypothesis of Sir Kenelm Digby, embraced by Dr Browne, the amber "being chafed or heated, is made to emit certain rays or files of uncouth steams, which, when they come to be a little cooled by the external air, are somewhat condensed, and having lost their former agitation, shrink back to the body whence they saluted out, and carry with them those light bodies that their farther ends happen to adhere to, at the time of their retraction. As when a drop of oil or syrup hangs from the end of a small stick, if that be dextrously and cautiously struck, the viscous substance will, by that impulse, be stretched out, and presently retracting, will bring along with it the dust of other light bodies that chanced to stick to the remotest parts of it."

The learned Gassendi has adopted the same hypothesis as the preceding, and he supposes that "these electrical rays being emitted several ways, and consequently crossing one another, get into the pores of the straw, or other light body to be attracted, and, by means of their decussation, take the faster hold of it, and have the greater force to carry it along with them, when they shrink back to the amber whence they are emitted."

As the preceding hypotheses were unaplicable to glass, which had not the property of emitting effluvium when heated, Descartes attempted to account for electrical attraction, by supposing certain particles shaped like small pieces of ribbon, to be harboured in the pores or crevices of glass, and to be emitted by friction, like the effluvium of amber.

The ingenious Mr Boyle, to whom some of the other physical sciences owe such lasting obligations, directed much of his attention to the subject of electricity, and has left us an account of his experiments, in a small work, entitled *Experiments and Notes about the Mechanical Origin and Production of Electricity*, Lond. 1675. He found that the hard transparent cake which remained after slowly evaporating the fourth part of good turpentine, was electrical, and that the same property was possessed by the dry mass which remained after distilling a mixture of petroleum, and strong spirit of nitre—by glass of antimony—glass of lead—caput mortuum of amber—the cornelian and the emerald, the two last of which had been supposed incapable of electrical excitation. Mr Boyle also made experiments with the diamond, and remarks that he never found any electric of the same bulk so vigorous as a rough diamond; with which he moved a needle about three minutes after he had ceased to charge it. The superiority of rough to polished diamonds he ascribes to the loss of "effluvial matter," during the operation of cutting and polishing. He found also that the electricity of all bodies is increased by torsion, as he calls it, or by wiping them before they are excited, which he supposes to remove whatever may tend to choke the pores of the amber.

In order to determine if the electrical influence was conveyed by the intervention of the air, he suspended a large piece of amber, well excited, in a small glass receiver, and over a light body, and after rapidly exhausting the receiver, the suspended amber was let down, till it came near the straw or feather, which was always attracted by the amber. In order to determine if an excited electric was acted upon by other bodies, he suspended his large piece of amber by a silken thread, and having excited it by a pin-cushion covered with a black woollen stuff, he allowed the amber to hang freely at the end of the string. As soon as the cushion hold steadily was brought near the suspended amber, it was drawn aside, and when the cushion was removed, it returned to its former position. "This power of approaching the cushion," says Mr Boyle, "was so durable on our vigorous piece of amber, that, by once charging it, I was able to make it follow the cushion no less than ten or twelve times. Whether from such experiments one may argu
t that 'tis but as 'tware by accident that amber attracts another body and not this the amber; and whether these ought to make us question if electrics may, with so much propriety as has been hitherto generally supposed, be said to attract, are doubts that my design does not here oblige me to examine." Like all his predecessors, Mr Boyle could not refrain from speculating on the causes of electrical phenomena. He supports the hypothesis of emitted and retracted effluvium, and replies to the objection of Descartes, by remarking that a "stinking odour" is actually emitted by glass, when two pieces of it are dextrously rubbed together.

While Mr Boyle was engaged in these experiments in England, the celebrated Otto Guericke, Burgomaster of Magdeburg, was successfully occupied with the same subject. Having filled a glass globe with melted sulphur, and afterwards removed the glass, he mounted his sphere of sulphur upon an axis, and performed many electrical experiments, with a new degree of facility. He observed the sound and the light which accompanied the excitation of the globe; he discovered, by means of a feather suspended near his globe, that a body, when once attracted by an excited electric, was afterwards repelled, till it had been touched by some other body; and that bodies, placed on an electric atmosphere, receive an electricity opposite to that of the atmosphere. This interesting result was obtained by suspending threads near the excited globe. He found that these threads were often repelled by his finger, and that a feather, when repelled by the globe, always turned the same side towards it.

The existence of electric light was discovered about the same time, in England, by Dr Wall. Having procured a long and tapering piece of amber, he drew it swiftly through a piece of woollen cloth, and he heard a prodigious number of little cracklings, each of which was accompanied with a small flash of light; but, by holding his finger at a little distance from the amber, he heard a loud snap, and saw it succeeded by a great flash of light. "It strikes the finger," says Dr Wall, "very sensibly, wheresoever applied;
with a push or puff like wind. This light and crackling seems in some degree to represent thunder and lightning.

Sir Isaac Newton is entitled to be mentioned in a history of electricity, more from the splendour of his name than from the contributions which he made to the progress of the science. He found, that when the upper surface of a plate of glass was excited by friction, light bodies were attracted to the opposite side; and in the History of the Royal Society, he has recorded the few experiments which he made upon this subject. In the 8th and 27th queries at the end of his Optics, he has introduced the subject of electricity in such a manner, as to convey some notion of the theoretical views which he had been to form. "A globe of glass," says he, "about 8 or 10 inches in diameter, being put into a frame, where it may be swiftly turned round its axis, will, in turning, shine where it rubs against the palm of one's hand applied to it. And if at the same time a piece of white paper, or a white cloth, or the end of one's finger, be held at the distance of about a quarter of an inch, or half an inch from that part of the glass where it is most in motion, the electric vapour, which is excited by the friction of the glass against the hand, will, by dashing against the white paper, cloth, or finger, be put into such an agitation as to emit light, and make the white paper, cloth, or finger, appear livid like a glow worm; and in rushing out of the glass, will sometimes push against the finger so as to be felt. And the same things have been found, by rubbing along a large cylinder, or glass, or amber, with a paper held in one's hand, and continuing the friction till the glass grew warm." "Let him also tell me," says he in the 27th query, "how an electric body can by friction emit an exhalation so rare and subtle, and yet so potent, as by its emission to cause no sensible diminution of the weight of the electric body, and to be expanded through a sphere whose diameter is above two feet, and yet to be able to agitate and carry up leaf copper, or leaf gold, at the distance of above a foot from the electric body?"

The subject of electricity, as well as other branches of natural philosophy, were about this time cultivated with assiduity by our countryman, Mr. Hawksbee. So early as the year 1705, he ascertained that light was produced by shaking mercury in glass vessels, and that the light became more brilliant when the air was reduced to half its density. He observed a similar light, when amber or glass was rubbed against flannel, glass against oyster shells, woolen against woolen, or glass against glass; but he was not at this time aware, that the phenomenon was electrical. In the course of his experiments, he found that sugar and carnelian when broken produced light; that mercury in a varnished vessel, shaken under an exhausted receiver, also exhibited light; and that an exhausted glass globe rubbed by the hand became luminous, the light being diminished by the admission of the air, but appearing on the point of his finger, or other bodies, when brought near the globe. The experiments of Mr. Hawksbee on electrical attraction and repulsion, were made with a pretty large glass cylinder, turned by a winch, and rubbed by his hand. Seven threads tied round a wire hoop, were attracted towards the axis of the cylinder, and this effect continued about four minutes after excitation. He afterwards found that the threads, when attracted by the cylinder, were repelled by his finger at a certain distance, and attracted by it when the distance was less. He observed also, that threads tied to the axis of the cylinder, diverged in all directions when the cylinder was excited, and were repelled by the finger when held on the opposite side of the glass. When the globe was at rest and unexcited, the threads were moved by the approach of an excited electric, excepting during moist weather.

When an exhausted globe was held within the effluvia of an excited one, he observed a light in the former, which gradually vanished when it was brought to rest, but which reappeared when the exhausted globe was put in motion. Upon presenting an exhausted tube to the effluvia of an excited globe, he perceived what he calls an interrupted flashing light. The experiments of Mr. Hawksbee on the great subtility of electric light, are extremely interesting. He lined more than half of the inside of a glass globe with sealing-wax, which in some places was one-eighth of an inch thick, and where it was thinnest it would just permit a candle to be seen through it in the dark. When this globe was exhausted and excited while in motion by his hand, Mr. Hawksbee saw the shape and figure of all the parts of his hand as distinctly upon the concave superficies of the wax within, as if no wax whatever had intervened between his eye and his hand. The same result was obtained, when pitch was substituted for sealing-wax. Melted flowers of sulphur did not produce the same effect; but common sulphur gave the same result as sealing-wax. When the quantity of common sulphur was large, the light within the globe was sometimes as great, but the shape of his fingers was not so distinctly seen as before. If a small portion of air was admitted into the globe when partially lined with sealing-wax, the light completely disappeared on the part covered with the wax, but not on that which was uncovered. When the globe was full of air, the attractive power of the coated part exceeded that of the uncoated part. Upon again exhausting the globe, the coated parts attracted bodies placed near the outside of the glass, but refused to exercise this force when the wax was removed.

Mr. Hawksbee's attention was next directed to the electricity produced by globes of sealing-wax, resin, and sulphur, having a globe of wood in their centre. The globular wax gave, in general, the same kind of electricity as glass, only differing from it in degree; but he could not make any of the electrical light adhere to his fingers, when it was placed near the excited wax. It was with great difficulty that he could excite the globe of sulphur, whereas a more powerful effect was produced with the globe of resin, (which had a little brick dust mixed with it) than with the sealing-wax. The sulphur exhibited very little light in the dark, and the resin none. Mr. Hawksbee endeavoured in vain to obtain electricity from brass; and from his attempting to explain this, by supposing that a small degree of attrition is not capable of "putting the parts into such a motion as to produce an electrical quality, owing to the firmness with which they adhere," it is evident, that he was unacquainted with the distinction between electrics and non-electrics.

After a considerable interval, during which electricity received no accessions, the subject was taken up by Mr. Stephen Gray, a pensioner at the Charter House, who enriched the science with the most important discoveries. Prior to the year 1728, Mr. Gray had repeatedly observed, that a down feather, tied to the end of a small stick, would cling to the stick after it was withdrawn from an excited tube, as if electricity had been communicated to the stick or to the feather. Hence he was led to the experiment of exciting the feather by drawing it between his fingers, and trying this, with a variety of other bodies, he discovered that feathers
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In February 1729, when Mr Gray was making experiments with a glass tube corked at one end, he was surprised to find that a feather was attracted and repelled by the cork. He then successively fixed to the excited tube a stick of fir, a brass wire, a pack-thread, iron, gold, silver, copper, tin, stones, bricks, wood, animals, and water, and found in every case, that the electric virtue was communicated most powerfully to their further extremity. In this way he tried long cones and reeds above 20 and 30 feet long, and obtained the same results. In attempting to convey the electric virtue to a great distance horizontally, Mr Gray's friend Mr Wheeler, found it necessary to suspend their horizontal line by little vertical lines, to prevent it from bending. When those supporting lines were silk, the electricity was communicated as formerly to the end of lines 124, 147, and 765 feet long; but the silk happening to break, and a piece of brass wire being substituted on account of its greater strength, they were astonished to find that the electric virtue was no longer transmitted, having been all carried off by the brass wire. In this way Mr Gray was led to the important general law, that non-electrics, such as the metals, were conductors of electricity, while electrics, such as glass, silk, hair, and rosin, were non-conductors, and may be employed for the purpose of insulating conductors, in order to convey electricity to any distance. In pursuing these enquiries, Mr Gray next found that he could convey the electric energy from the excited tube to a thread and to a rod without bringing them into contact with the tube, and that a bubble of water, water itself, and all animal bodies, were likewise conductors of electricity.

Mr Gray's attention was next directed to the electrical qualities of rosin, gum lac, shell lac, bees wax, sulphur, and pitch. Having melted in a spherical iron ladle all these substances except the sulphur, either separately, or when two or three of them were compounded, he discovered, that when they were taken out of the ladle, and had their spherical surfaces hardened, they would not attract light bodies until they came down to a certain temperature. The attractive power being then developed, increased during the operation of cooling, and became very considerable when the bodies were cold. Having wrapped the smallest of these bodies in white paper, and the larger ones in white flannel, or in black worsted, he enclosed them in a large fir box, and he found that after 30 days, they were as powerfully attractive as on the first or second day; and that at the end of four months, (the time when he was writing,) they still retained their power. He always melted the sulphur in a glass vessel, and he once obtained a large and curious stone of stone sulphur, which was made in a wine glass, and which he had always kept covered by the wine-glass itself. When the glass was removed, the cone attracted to it bodies as powerfully as the other piece of sulphur which was preserved covered in the box. The glass itself exhibited an attractive power in fair weather, but it was inferior to that of the sulphur, which preserved its efficacy in all weathers. A cake of sulphur which he had kept for months, had only one- tenth of the attractive force of the cone. Mr Gray, in company with Mr Wheeler, discovered, about the end of August 1732, that a thread suspended in a receiver was attracted by the receiver when excited, or by an excited tube, after the air was exhausted; and Mr Wheeler afterwards obtained the same result when the attraction passed through five receivers all exhausted.

Contemporary with Mr Gray in this career of discovery, was M. Dufay, Intendant of the Royal Gardens, and Member of the Academy of Sciences at Paris. His experiments were published in six long memoirs, inserted among those of the Academy of Sciences for 1733 and 1734, and entitle him to be considered as having widely enlarged the boundaries of electrical science. He discovered that all bodies excepting metals, fluids, and sulphur, which are softened by heat or dissolved by water, could be made electric by first heating them, and then rubbing them with any kind of cloth, the softest bodies requiring in general a greater degree of friction; and in repeating Mr Gray's experiments on water, he found that all bodies, whether solid or fluid, were capable of receiving electricity when placed on glass, which was either dry or slightly warmed. He found also that the electric virtue was more easily communicated by pack-thread when it was wetted, and in this way he conveyed it along a string 1256 feet long. M. Dufay had also the good fortune to be the first who observed the electric spark from a living body when suspended on silk lines; and he has described the sensations which he experienced when electrified in an insulated position. The most important discoveries of M. Dufay were two general laws, which enabled him to classify a great number of obscure and inexplicable facts. He discovered, 1. That electric bodies attract all those that are not so, communicate electricity to them, and then repel them as soon as they become electric. And, 2. That there are two distinct kinds of electricity, very different from one another, one of which he calls vitreous, and the other resinous electricity. The vitreous electricity is exhibited by glass, rock crystal, precious stones, hair of animals, wool, and many other bodies, while the resinous electricity is possessed by amber, coal, gum lac, silk, thread, paper, and a great number of other substances. A body possessing vitreous electricity repels all bodies having vitreous electricity, and attracts all that have resinous electricity, and vice versa, or in other words, bodies having the same electricity repel each other, and those which have contrary electricity attract each other. He likewise found, that communicated electricity was always of the same kind as that of the body which communicated it; and that a tube full of condensed air was not capable of being excited.

As soon as Mr Gray was made acquainted with M. Dufay's experiments, he repeated the greater part of them, and was led to some new and interesting results. M. Dufay had observed, that a piece of iron drew sparks from the human body, when insulated by silk cords; from which Mr Gray concluded, that the same effect would be produced if the metal and the human body changed places. He therefore suspended the poker, the tongs, &c., before an excited electric, and found that they gave sparks exactly like the human body. Hence originated metallic conductors, which now form essential parts of an electrifying machine. Mr Gray likewise found, that knobs gave greater sparks than
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points, and that wood was a much less perfect conductor of electricity than the metals; and he very sagaciously conjectured, "that there may be found out a way to collect a greater quantity of the electrical fire, and consequently to increase the force of that power, which, by several of these experiments, si licet magna componere parsis, seems to be of the same nature with that of thunder and lightning." The last labours of Mr Gray in this field of discovery, were not marked with the same genius which he had already exhibited. These experiments related to the resolution of small bodies round great electrics. "This motion," says he, "will constantly be the same way that the planets move about the sun, viz. from the right hand to the left, or from west to east. But these little planets, if I may so call them, move much faster in their apogee then in the perigee parts of their orbit, which is directly contrary to the motion of the planets about the sun." This paragraph was the last that Mr Gray ever wrote. He dictated to Dr Mortimer, on his death-bed, the other experiments which he had made upon this subject; but as they were almost all fallacious, they are not worthy of being recorded in a history of electricity.

Mr Wheeler, whom we have already mentioned as the associate of Mr Gray in several of his researches, made a considerable number of experiments by himself. These experiments related to the repulsive force of electricity, and were made in the autumn of 1732, and repeated before Mr Gray in the summer of 1731. The results of these experiments were: 1. That bodies made electrical by communication with an excited electric, are in a state of repulsion with regard to such excited bodies. 2. That two or more bodies made electrical by communicating with an excited electric, are in a state of repulsion with respect to one another. 3. Excited electrics do themselves repel one another. These results are the very same as those obtained by Mr Dunfay; and there is every reason to believe, that they were obtained before Mr Wheeler had any knowledge of the labours of the French philosopher. The experiment by which he proved the second of his observations, is remarkably beautiful. When a number of silk threads, tied together by a knot at each extremity, were electrified, they were expanded in a fine spherical shape by their mutual repulsion, so that the lower knot was made to ascend. Mr Wheeler conceived this experiment as exhibiting the action of a bundle of muscular fibres, and as suggesting a reason for the dissolution of bodies in menstrum.

Dr Desaguliers, the next philosopher who added to our electrical knowledge, informs us, that he was deterred from pursuing this science, from the peculiar temper of Mr Gray, who would have abandoned the investigation entirely, if he imagined that any thing was done in opposition to him. The death of Mr Gray relieved Dr Desaguliers from this embarrassment; and he accordingly devoted much of his attention to this curious subject. His success, however, was not proportionate to his labour; and he appears to have had a greater talent for giving a clear and succinct account of the discoveries of others, than for original investigation. He found, while endeavouring to electrify a burning tobacco candle, that the thread of trial, but not within two or three inches of the flame; and that, as soon as the candle was blown out, every part of it attracted the thread. The result was the same with a wax candle. He observed, that a glass receiver exhibits marks of electricity merely by being warmed, and that sometimes resin and wax would exert their electricity simply by exposure to the open air. Dr Desaguliers was the first who ranked pure air among electrics; and hence he endeavours to account for the rise of vapours on electrical principles. In 1712 he published an excellent dissertation on electricity, containing a complete account of all that had been done upon that subject; and he had the honour of receiving, for this work, the prize medal of the Academy of Bourdeaux. Dr Desaguliers was the first who distinguished bodies into electrics and conductors; and he gave a list of substances which belong to these two classes.

About this time the subject of electricity began to be assiduously cultivated by the Germans. Professor Boze of Wittenberg revived the use of the globe of glass, and added a prime conductor, which consisted of an iron or tin tube, at first supported by a man standing upon cakes of rosin, and afterwards by silk strings. Professor Winkler invented the cushion for exciting the globe; and Mr Gordon, a Scotch Benedictine monk, and professor of philosophy at Erfurt, had the merit of first introducing the cylinder of glass. The apparatus used in Germany was much more various and powerful than what had been employed either in France or England; and hence the foreign experimenters were led to several interesting results. In 1744, Dr Ludolf, of Berlin, set fire to the ethereal spirits of Frobenius, by the sparks from a glass tube, and also by those from an iron conductor. Professor Winkler performed the same thing by a spark from his finger, and also kindled French brandy, corn spirits, and other still weaker spirits, after they were previously heated. Oil, pitch, and sealing-wax, when heated to a very great degree, were also kindled by the electric spark.

A number of amusing experiments were about this time introduced by the Germans. Mr Winkler constructed a wheel which moved by means of electricity. Mr Boze conveyed electricity from one man to another, 15 feet distant, by a jet of water; and Mr Gordon also kindled spirits by a jet of electrified water. Dr Miller, in 1745, succeeded in kindling phosphorus by the electric spark.

Our countryman, Dr Watson, afterwards Sir William Watson, now began his successful career as an electrical discoverer. His attention seems to have been directed to this subject by the discoveries of the Germans, which he carefully repeated. He fired inflammable air by the electric spark; and, by means of a drop of cold water, and even with ice, he kindled both spirits of wine and inflammable air. He also succeeded in firing gun-powder, and in discharging a musket by electricity, when the gun-powder had been prepared by the admixture of a little camphor. In the experiments of the Germans, the substances which were set on fire were always held by some person who was not electrified; but Dr Watson performed all the experiments by what he has called the repulsive power of electricity, the fluid being held by an electrified person, and then touched by the finger of a person not electrified. He observed, that electricity experienced no deviation from its rectilinear direction, in passing through glass. The electricity transmitted through the glass, was always strongest when the glass was warm. He showed that the fire of electricity was neither affected by the presence nor absence of other fire; that the smoke of original electrics was a conductor of electricity; and that the flame of a candle was a perfect conductor. The attention of Dr Watson was next occupied by the subject of the Leyden phial, which was at
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This time invented at Leyden for the purpose of accumulating considerable quantities of electricity. He endeavoured in vain to give a theory of its operations; but he obtained a number of curious results, which, though of importance at the time when he wrote, could not with propriety be introduced into a short history of electricity. Dr Watson was now at the head of a small party of English philosophers, who associated themselves for the purpose of making a series of experiments on the distance to which the electric shock could be carried, and on the velocity of its motion. On the 14th and 18th of July 1747, they conveyed the shock across the Thames at Westminster, by an iron wire, the water of the river forming part of the chain of communication. One of the party held a wire in one hand, which communicated with the phial, and received the shock by dipping an iron rod in the river. On the 24th of July, at two different places, they forced the electric shock to make a circuit of two miles at the New River at Stoke Newington. At one of these places, the distance by land was 800 feet, and by water 2000; in the other, the distance by land was 8900, and 8900 by water. In other experiments, they found that meadow-ground, covered with grass, conducted the electricity well; and that dry, gravelly ground, was as good a conductor as water. On the 14th of August 1747, in the driest weather, the association assembled on Shooter's Hill, for the purpose of performing a very magnificent experiment. The wire which communicated with the iron rod that made the discharge, was supported by rods of baked wood, and was 6732 feet long. The wire communicating with the phial was supported in a similar manner, and was 3868 feet in length; the distance of the observers being about two miles. Although the circuit was four miles, two of water and two of dry ground, yet no time appeared to elapse during the passage of the shock; so that there was every reason to consider it as instantaneous. In another experiment of the same kind, where the whole length of the wire was 12,276, the same result was obtained. After the completion of these experiments, Dr Watson commenced his individual labours. He discovered that glass tubes and globes did not contain the electrical power in themselves, but were merely movers, or, as he calls it, determiners of that power; and, before any notice of Dr Franklin's celebrated discovery had reached England, Dr Watson had communicated to the Royal Society of London a theory of positive and negative electricity.

While electricity was making such progress in England, Dr Franklin was busily occupied with the same subject in America. The extent and brilliancy of his discoveries gave a form and dignity to the science of electricity which it had never before possessed, and raised their author to a high rank among the distinguished philosophers of the eighteenth century. His earliest discoveries were communicated to his friend Mr Collinson of the Royal Society, on the 26th July 1747, and the letters which contained them were speedily translated into the different languages of Europe. These discoveries related to almost every branch of electricity; but the most important may be reduced to three. 1st, His discovery of plus and minus electricity. 2d, His explanation of the Leyden phial. 3d, His discovery of the identity of lightning and electricity.

Dr Franklin had observed, like Dr Watson, that electricity was not created by the friction of the glass, but was merely collected by that operation from neighbouring non-electrics. He had likewise noticed, that no person could electrify himself, even when standing upon wax or glass, as the tube which he rubbed could communicate to him no more electric matter than it had received from him during excitation; and he had seen, that when two persons stood upon wax, they both seemed to be electrified when one of them rubbed the tube and the other took the fire from it; and that the spark between them was stronger when they touched one another after that operation, than when any other person touched one of them. Hence Franklin was led to conclude, that the electric matter was conveyed from the person who excited the tube to the person who touched it; and he therefore supposed that he who touched the tube received an additional quantity of electricity to what he had naturally, or was electrified plus or positively, while the person that excited the tube was deprived of a part of his natural quantity of the electric fluid, or was electrified minus or negatively. According to this system, therefore, every body has a natural quantity of electricity; and this body may be excited either by increasing or diminishing that natural quantity.

2. This simple theory found a ready and a beautiful application in the explanation of the Leyden phial. This apparatus, which was discovered by Muschenbroek, is nothing more than a glass jar coated both on the outside and inside to within a certain distance of the top with a conducting substance, such as tin-foil. If the internal coating is connected by a wire with an excited tube, or with the electrified conductor of an electrical machine, while the external coating is connected with the ground, or with any conducting substance, a great quantity of electric matter may be accumulated in the jar. If a communication is now made by means of a conductor between the internal and external coating, a loud snap is heard, and a brilliant spark emitted; and if the conductor is a living being, he will receive a severe shock in his arm and heart, proportional to the coated surface of the jar, or rather to the quantity of electricity which has been collected. When the phial is thus discharged, the accumulated electricity has escaped, and the phial is in the same state in which it was before the commencement of the experiment. When the electric shock was first discovered, the philosophers themselves were thrown into such a tumult of wonder and surprise, that they published the most ridiculous and exaggerated accounts of the effects which it produced. Muschenbroek received such a concussion in his arms, shoulder, and heart, that he lost his breath, and required two days to recover from the effects of the blow and the terror, and declared that the kingdom of France would not induce him to take another shock. M. Allamand lost the use of his breath for some moments, and afterwards experienced along his right arm such an acute pain, that he apprehended serious consequences from it. Mr Winkler tells us, that his body was thrown into such convulsions, and his blood into such an agitation, that he employed cooling medicines to keep off fever. At another time, he bled copiously at the nose; and the same effect was produced upon his wife, who was almost deprived of the power of walking. These remarkable effects of the electric fluid excited the attention of all classes of people. The learned and the vulgar were equally desirous to experience the singular sensation; and crowds of half-taught electricians wandered through every part of Europe to gratify the universal curiosity. It was only the curiosity of the unlearned, however, that was satisfied. The electrical philosophers endeavoured in vain to account
for the operation of the Leyden phial; and it was not till the Franklinian theory was discovered, that it received a proper explanation.

This explanation consists in supposing, that when one side of the glass jar was electrified positively, the other was electrified negatively, so that the charging of the phial consisted merely in diminishing the quantity of the electric matter in one side of the glass, and accumulating electric matter in the other. Dr Franklin had observed, that the outside coating was always negative, when the inside coating was positive; and he proved the truth of this, by the attraction and repulsion of a cork ball suspended by silk. When a cork ball was suspended between the wires communicating with each coating, and brought near one another, it was alternately attracted and repelled by each wire, till the phial was discharged.

In order to show, that in the charging of a phial, the one side lost as much as the other gained, he suspended a small linen thread near the coating of a charged phial, and observed that the coating attracted the thread whenever he brought his finger near the wire, the outside coating drawing in by the thread the same quantity that was taken from the inside by touching the wire. Several experiments enabled Dr Franklin to prove, that, in the discharge of the phial, the quantity of electricity which left the one side of the phial, was equal to that which was received by the other. In one of these, he insulated the rubber of his machine, and found, that a phial, suspended from the conductor, could not be charged, even though his hand was constantly applied to it; for, though the electric matter left the outside, there was none to be accumulated on the inside. Upon removing his hand, and connecting the outside coating and the insulated rubber by a conducting substance, the phial was easily charged. Hence it followed, that the very same electric matter which left the external coating, was conveyed by the way of the globe, the conductor, and the wire of the phial, into the inside of the jar.

3. Hitherto, the science of electricity embraced no wider range than the phenomena developed during the excitation of glass and other electrics, and had therefore not yet connected itself with any of the great events of the material world. Astronomy had elevated the mind to the contemplation of the most splendid and magnificent phenomena which the imagination could comprehend; Optics had dared to investigate the properties of that ethereal matter, which constitutes the very soul of the visible world; and Magnetism had connected her facts with the polar attraction of the great globe itself. It had indeed been conjectured, that the shock and spark of the electrical machine, were miniature effects of a more tremendous agent; but it was reserved for Dr Franklin, not only to give a form and character to this infant science, but to raise it to a higher rank among the other great divisions of human knowledge. The discovery of the identity of electricity and lightning was the step by which this great change was effected. The vulgar were astonished at the sight of fire brought down from heaven; and philosophers themselves startled at the recollection, that they had been amusing themselves with a thunderbolt in their hands, and trifling with that terrible agent, which had so often alarmed and convulsed the physical world. Human genius indeed seems on this occasion to have made an impious excursion beyond its mortal range; and one victim was demanded to expiate the audacious attempt.

Suspecting that the electric fluid was similar to that which produced lightning, Dr Franklin drew up a statement of the principal points in which these two agents resembled each other. He found that flashes of lightning, like the electric spark, are generally seen crooked and wavy in the air; that lightning, as well as electricity, strikes pointed objects in preference to all others; that lightning and electricity take the readiest and the best conductor; that they both dissolve metals, and inflame combustible substances; that they rend solid bodies, strike persons blind, reverse the poles of a magnet, and destroy animal life. These points of resemblance appeared to Dr Franklin so very striking, that he resolved to examine, by direct experiment, the truth of his conjecture. For some time he waited for the ejection of a spire in Philadelphia, to assist him in his views; but he afterwards thought of a more simple method of carrying them into effect. Having extended a large silk handkerchief over two cross sticks, he formed a kite, which, unknown to any person but his son, he elevated during the first thunder storm, which happened in the month of June 1752. The kite remained a considerable time in the atmosphere without any appearance of electricity. A cloud, which had the appearance of being charged with lightning, passed over it without producing any result; and Dr Franklin began to despair of success. His attention, however, was roused by the ejection of some loose fibres on the hempen cord, and on holding his knuckles to the key upon the string, he received an electric spark. Before the rain had wetted the string, other sparks were obtained; but when the string was thoroughly wet, Dr Franklin collected the electric fire in great abundance. About a month before Dr Franklin had made these successful trials, the French philosophers had obtained similar results. In order to shew, by direct experiment, that the electricity collected from the atmosphere had the same properties as that which was generated by the friction of an electric, he erected an apparatus in his house at Philadelphia, consisting of an insulated iron rod connected with two bells, which indicated by their ringing that the rod was electrified. After numerous trials, he found that the natural and artificial electrics were in every respect the same; that the clouds were sometimes negatively, and sometimes positively electrified; and that sometimes, in the course of a thunder storm, they changed several times from positive to negative. On one occasion, when there was no thunder at all, he found the air to be strongly electrified during a fall of snow.

The great practical application of the preceding discoveries to the protection of buildings from the destructive effects of lightning, contributed most essentially to extend the fame of Dr Franklin's discovery; and every conductor that has been reared for this purpose, may be regarded as a monument to the genius of the American philosopher. We are disposed to doubt, however, whether this application has been as useful as it at first promised. When a thunder cloud is directly above, and not far distant from, a conductor, the electric fluid will certainly be conveyed into the earth by the conducting power of the iron rod; but there have been numerous instances where one end of a house has been destroyed by lightning, when there was a conductor placed at the other.

A great variety of miscellaneous and important experiments were made about this time by Le Monnier the younger, Mr Smekton, and Dr Miles. Le Monnier made a great number of experiments with a very powe-
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The subject of electricity was cultivated by the Abbé Nollet with great assiduity and success. He was the friend and associate of Dufay, and was worthy of succeeding him in his career of discovery. He observed that electricity of a body placed in the atmosphere of an electrified body, was of the same kind with that of the electrified body, a result, however, which was found to be incorrect; that pointed bodies threw out brushes of electrical light, but did not display other signs of electricity so powerfully as blunt bodies; that the smoke of gum lac, turpentine, karabé, and sulphur, were not so good conductors of electricity as the smoke of linen, wood, the vapour of water, and the effluvia of burning tallow and other fat substances; that a piece of redhot iron throwing off ignited sparks, and placed at the distance of 6 inches from an excited tube, deprived it in two or three seconds of all its electricity, but refused to affect the tube at the same distance before it ceased to be red; that an excited tube lost none of its electricity in the focus of a burning mirror; that glass and other electrics were more strongly excited in the open air than in vacuo; that the electric light in vacuo was more diffuse and unbroken than in the open air; and that oil of turpentine, upon a piece of woollen cloth, was capable of exciting glass very powerfully, but lost this quality by the least intermixture of water. The Abbé Nollet was the first person who made any accurate experiments on animal and organised bodies. This series of experiments he began with several on evaporation, &c. He ascertained that electricity augments the natural evaporation of fluids, and that those evaporate most in this way that are most evaporable in ordinary cases; that electricity has the greatest effect in evaporating fluids, when they are contained in vessels that are non-electric, and that it does not make fluids evaporate through the pores either of metal or glass. Mr Boze having informed the Abbé Nollet that capillary tubes which discharges water only by drops, afforded a constant stream when electrified, he made numerous experiments on that subject. He found that the stream of water was neither sensibly accelerated nor retarded when the bore was above a line in diameter. When it was a line in diameter, the fluid experienced a small acceleration, and when it was capillary, the electrified jet not only became a continued stream, and divided into several streams, but was also considerably accelerated, and this in proportion to the smallness of the bore. The stream of electrified fluid exhibited in these experiments had a very brilliant effect when they were performed in the dark. The Abbé's attention was now directed to the effect of electricity upon vegetables. The first experiments on this subject had been made at Edinburgh, in October 1746, by Mr Maimey, who found that two mealy trees, electrified during the month of October, put forth small branches and blossoms much earlier than other shrubs that had not been electrified. The Abbé repeated this experiment. He sowed seeds in two pots, filled with the same mould, and kept in the same place. One of the pots was electrified during 13 days, two, three, or four hours a day, while the other remained unelec- trified; and it always happened that the electrified pot exhibited sprouts two or three days sooner than the rest, and threw out larger shoots, and a greater number of them in a given time.

In extending his experiments to animals, the Abbé Nollet took several pairs of cats, pigeons, chaffinches, sparrows, &c. and placed them in different cages. After electrifying one of each pair for five or six hours at a time, he weighed them accurately, and always found that the electrified cat was 65 or 70 grains lighter than the other, the pigeon from 32 to 38 grains lighter, and the chaffinch and sparrow six or seven grains. Hence he concluded that electricity increases the insensible perspiration of animals.

Upon these and other results, the Abbé Nollet founded a theory of electricity, which was never received by any other philosopher. He imagined that when an electric is excited, the fluid has two opposite motions, viz. an efflux to the electric and an influx from it. In consequence of the efflux, all light bodies are attracted or carried towards the electric, while, in consequence of the influx, all light bodies are carried from the electric or repelled. Hence he was obliged to suppose, that every electric, as well as every body which receives electricity, has two different kinds of pores; one for receiving, and the other for emitting the electric matter.

About this time a very simple and ingenious theory was brought forward by Mr Ellicott, a fellow of the Royal Society of London, which is remarkable as being almost exactly the same as that which was afterwards so fully illustrated by Espinus and Cavendish. After reciting the principal electrical phenomena, he draws from them the following conclusions: 1. That the phenomena of electricity are produced by means of effluvia, which, in exciting the electrical body, are put into motion and separated from it. 2. That the particles composing those effluvia strongly repel each other; and, 3. That there is a mutual attraction between these particles and those of all other bodies. Mr Ellicott afterwards proceeds to explain, upon these principles, a variety of electrical experiments. See Phil. Trans. 1748, vol. iv. p. 195.

During the years 1747 and 1748, the attention of philosophers was drawn to a series of experiments on the
medical effects of electricity, said to have been performed at Venice, and repeated at Leipsic. J. Francisco Pivati, a gentleman of eminence at Venice, published a pamphlet in Italian, containing an account of these experiments. He inclosed in a glass cylinder a quantity of balsam of Peru, so that none of its effluvia could escape; and with that cylinder he electrified a man who had been afflicted with a severe pain in his side. As soon as the patient returned home, he fell asleep and perspired; and so powerfully had the balsam been transpired through the pores of the glass cylinder into his body, that his clothes, his hair, and his bed, were filled with the effluvia. On the following day Pivati electrified another person who was in good health. In the course of half an hour a warmth was gradually diffused through his whole frame, and he became unusually cheerful. An odour was emitted from his body, and was distinctly perceptible to his companion. Induced by these results, Professor Winkler of Leipsic repeated the same experiments with success. He found that bent sulphur, which, when enclosed in a glass sphere, emitted no odour by being burned over the fire, sent forth a sulphurous vapour, when electrified, to the distance of 10 feet. His friend Professor Haubold, and other visitors, were obliged to leave the room from the intensity of the smell, and the professor’s clothes were impregnated next day with the sulphuric vapour. He afterwards diffused the odour of cinnamon and balsam of Peru in a similar manner, and in both these cases the effects of the odour remained on the day following. The experiment was again tried upon a person ignorant of what was doing, and he distinctly stated that his nose was filled with a sweet smell like some sort of balsam. Encouraged by the success of his first experiments, Pivati drew sparks, for some minutes, from an ulcerated foot, which had resisted every surgical application, by means of a glass cylinder filled with proper materials. In the morning, the patient found a red tumour on his foot. He perspired every night for eight days, and was then perfectly recovered. The Bishop of Sebenico, an old man of 75, who was miserably afflicted with the gout, was attracted to Venice by the fame of Pivati’s cures. His fingers were immovable, and his legs incapable of bending; but as soon as he had been electrified from a glass cylinder filled with discutient medicines, “his Lordship opened and shut both his hands, gave a hearty squeeze with his hand to one of his attendants, rose up, walked, smote his hands together, helped himself to a chair, and sat down, wondering at his strength, and hardly knowing whether or not it was a dream. He walked out of the chamber, and down stairs, without any assistance, and with the agility of a young man. Soon afterwards Pivati electrified a lad, 61 years old, in like manner, from the gout, with which she had been six months tormented. Her fingers were much swollen, and, always trembling, and one of her arms was convulsed. After receiving the electricity for two minutes, the trembling of her fingers ceased, and the next day the swelling was so far abated, that she could draw on her gloves, and make use of her fingers.” See Phil. Trans. 1748, vol. xiv. p. 202.

As soon as these results were known over Europe, every electrician endeavoured in vain to verify them. The Abbé Nollet undertook a journey to Italy, for the purpose of visiting the different experimenters by whom they were published. He repeated the experiments in their own presence; and though he found that in particular cases, such as disorders of the eyes, the ear, and the head, and in some cases of paralysis, the patients had found considerable relief; yet he was convinced, that, in other instances, the effects were greatly exaggerated; and in no one case could he find any transpiration of odours through glass, or any communication of the effects of drugs to persons who were electrified with them in their hands. The British electricians were equally desirous with the Abbé Nollet, either to confirm or refute the experiments of Pivati. They had both tried without success by the members of the Royal Society; and an account of Winkler’s and Pivati’s experiments had appeared among the transactions of that learned body, the secretary was desired to request from Mr. Winkler a circumstantial account of his experiments; and a loan of some of the globes and tubes by which he had obtained such singular results. The German electrician readily complied with this request; and Dr. Watson was appointed to conduct the experiments at his own house, on the 12th of June 1751, before the president and office-bearers of the Royal Society. Notwithstanding every precaution; however, in obeying the instructions of Mr. Winkler, they were unable to force through glass the effluvia of odoriferous bodies.

Mr. Canton, one of the most eminent of the English electricians, had early distinguished himself by a successful repetition of Dr. Franklin’s method of drawing electricity from the atmosphere during a thunderstorm. He was the first who discovered that air was capable of receiving electricity by communication, and of retaining it for a considerable time; and, by a delicate apparatus, he even measured the quantity of electricity which it had received. He found also a method of electrifying, to a considerable degree, the whole air of a room, either positively or negatively. In the year 1753, he even succeeded in electrifying a room to such a pitch that it retained its electricity for some time. In very dry weather, the electricity thus communicated sometimes continued above an hour.

Hitherto the same electricity had always been produced by the same electric; a result which had been introduced into the very terms of vitreous and resinous electricity. It was reserved, however, for Mr. Canton to dispel this long established result, and to shew that every electric was capable of affording both kinds of electricity, according to the state of the surface of the body, and according to the nature of the rubber by which that surface was excited. Mr. Canton had found before he completed this great discovery, that he could communicate positive electricity to sealing-wax. The stick was two feet and a half long, and one inch in diameter; and when an excited glass tube was drawn several times over one part of it without touching the other, the half thus excited was positively, while the other was negatively electrified. In December 1758, Mr. Canton removed the polish from a glass tube by grinding it with emery and sheet-lead; and, upon exciting it with new flannel, he found that it possessed negative electricity, but when it was excited by a piece of dry oiled silk, it exhibited signs of positive electricity. If the rough tube be all greased over with tallow, and as much of the tallow as possible wiped off with a napkin, the oiled silk will receive a polish by rubbing it, and after a few strokes, the tube will exhibit signs of negative electricity. When the oiled silk is covered with chalk or whitening, the greased rough tube will give positive electricity; but by continuing the friction till the rub-
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Having observed that the friction of mercury, included in a glass tube, not only produced electrical light, but also electrified the glass on the outside, Mr Canton plunged a piece of dry glass in a basin of mercury, and found that by taking it out, the mercury was electrified negatively and the glass positively, and to a considerable degree. He likewise found that amber, sealing-wax, and Iceland crystal, were all electrified positively when taken out of mercury. From these experiments, Mr Canton was led to the discovery of an amalgam of mercury and tin, which he always found highly efficacious in the excitation of glass. The subject of electric atmospheres was also illustrated by some fine experiments of Mr Canton. These experiments exhibit a curious variety of attractions and repulsions of electrified bodies under different circumstances, and led to the establishment of the general fact, that bodies immersed in electric atmospheres always become possessed of the electricity contrary to that of the body into whose atmosphere they are plunged.

Contemporary with Mr Canton, was Giambattista Beccaria, who has laid the science of electricity under great obligations, and has published his discoveries in a work entitled, Dell' elettricismo artificiale e naturale, which appeared at Turin in 1753, and was translated into English in 1776. Having no knowledge of the experiments of Mr Canton, Beccaria made the same discovery respecting the communication of electricity to the air. He demonstrates that the air which is adjacent to an electrified body acquires gradually the same electricity; that the electricity of the body is counteracted and diminished by this electricity of the air; and that the air parts with its electricity very slowly. He also found that there was a mutual repulsion between the particles of the air and electric matter, and that a temporary vacuum is formed by the electric fluid in passing through any portion of air. His experiments on water are equally interesting and important. He has shown that water is a very imperfect conductor of the electric fluid; that it conducts electricity according to its quantity; and that a small quantity of water makes a great resistance to the electric fluid. Small tubes of water, for example, when forming part of the electric circuit, refused to transmit a shock, while it was readily conveyed by tubes of a larger bore. He even made the electric spark visible in water, by inserting wires nearly meeting in tubes filled with water, and discharging shocks through them. The electric spark appeared as if no water had been present; but the tubes, though often 8 or 10 lines thick, were generally broken to pieces with tremendous force. The same philosopher discovered also that metals were not perfect conductors; and by suspending a wire of 500 Paris feet in length, and using a pendulum vibrating half seconds, he thought that he could determine the rate at which the electric fluid advanced. Light bodies, for example, placed at one end of the wire, did not move till one vibration after a charged phial had been applied at the other extremity. When a hemp cord was used, five or six vibrations elapsed, and only three or four when the cord was wetted.

These experiments of Signor Beccaria, valuable as they are, were greatly surpassed by those which he made on the electrical phenomena of the atmosphere. An account of these experiments, however, would require us to enter into a minutness of detail which is inconsistent with a general history of electricity. They will be given with more propriety in another part of the article.

About this time, the death of Professor Richman of St Petersburg, while employed in bringing electricity from the heavens, created a great sensation in the scientific world, and is well entitled to be particularly mentioned in a history of electricity. This eminent individual was engaged in a work on the electricity of the atmosphere; and was therefore extremely desirous of observing the electrical state of the air during thunder storms. On the 6th of August 1753, he had prepared his apparatus for observation. From a metallic rod passing through a perforated bottle, and fixed upon the roof of his house, there passed a chain surrounded with electrics. The other end of this chain was fixed to another metallic rod placed in a glass vessel, and to this second rod was attached a linen thread, which marked, by its elevation on a quadrant, the intensity of the electricity of the rod.

While Professor Richman was attending an ordinary meeting of the Academy of Sciences in the forenoon, his attention was excited by the sound of distant thunder. He immediately set off for his own house to observe the electrical state of the air, and took with him his engraver Sokolow, that he might be enabled to give a better representation of any phenomena that should present themselves. Richman remarked, that the thread pointed to four degrees on his quadrant; and while he was describing to his friend the dangerous consequences that might ensue if the thread rose to 45°, a dreadful clap of thunder alarmed all the inhabitants of St Petersburg. Richman inclined his head to the gnomon to see the degree of electricity which was indicated, and when he was in that bent posture, with his head about a foot distant from the rod, a large globe of white and bluish fire, about the size of Mr Sokolow’s fist, flashed from the rod to his head, with a report as loud as that of a pistol. The Professor fell back upon a chest behind him, and instantly expired. Sokolow was stupified and benumbed by a sort of steam or vapour, and was struck by several fragments of the red-hot wires; and the moment he recovered, he ran out of the house, acquainting every person whom he saw with the accident. In the mean time, Mrs Richman, who heard the stroke of thunder, hastened to the chamber, and found her husband without any appearance of life, in the attitude of sitting upon the chest, and leaning against the wall. The house was filled with a sulphurous vapour; an English clock was stopped in an adjoining room, the ashes were thrown from the fire-place, and the door-posts of the house were rent asunder. As soon as medical assistance was obtained, a vein of the Professor’s body was opened, but no blood flowed, and every attempt to restore life by violent shaking, and other means, were wholly fruitless. When the body was turned upside down, a small quantity of blood fell from the mouth during the rubbing, and on the forehead appeared a

**Discoveries of Beccaria.**

Born 1716.

Died 1781.
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red spot, from the pores of which some drops of blood oozed, without wounding the skin. The shoe on the left foot was burst open, and below the aperture there was a blue mark on the foot, from which it is probable that the electricity had issued. Several red and blue spots resembling leather shrunk by being burnt, appeared on the left side, on the back, and on other parts of the body. The stocking was entire at the place where the shoe was burst, and the coat had received no damage. The back of the engraver's coat, however, was marked with several long and narrow burnt stripes. Upon opening the body 24 hours after the accident, the cranium and brain were uninjured; some extravasated blood appeared in the cavities below the lungs, and in the lungs towards the back, which were of a brownish-black colour. The throat, glands, and the thin intestines, were all inflamed, but none of the entrails were touched. The singed leather-coloured spots merely penetrated the skin; and 48 hours after death, the body was completely corrupted. It is a curious circumstance, that Professor Richman had in his left coat pocket 70 rubles of silver, which were not in the least degree affected.

Our countryman, Mr Delaval, a member of the Royal Society, contributed considerably to the progress of electricity. He found that the calces of metals, such as ceruse, lead ashes, minium, cals of antimony, &c. are all non-conductors, although metals themselves are the most perfect conductors. Animal and vegetable solids also, when reduced to ashes, were likewise non-conductors. A piece of Portland stone, which conducted perfectly well, became a non-conductor when powdered, exactly like the oxides of metals; and after making similar experiments with pounded alum, and gum arabic, Mr Delaval believed that all bodies that can be pulvissed in the mortar will have the same property. Having formed some of the Portland stone, (granular limestone) into plates nearly as thin as window-glass, he heated them to a proper degree, and coated them on both sides with metal, in order to perform the Leyden experiment. When the heat was great enough to singe paper, the stone conducts as perfectly as when cold. Upon cooling, it begins to lose its conducting power and afford small shocks, which increase in intensity for ten minutes, and then continue the same for fifteen minutes. The shocks then became weaker as the stone cooled, and completely ceased a little while before the stone was cold. The same result was obtained with tobacco pipes. These results were attributed, by Mr Canton, with great reason, to the moisture contained in the Portland stone and the tobacco pipe. When they are heated, the moisture is expelled, and the conducting power destroyed; and when they begin to cool, the moisture is absorbed, and the conducting power restored. Mr Delaval made some curious experiments on calcareous spar. After being rubbed, when the heat of the air is moderate, it shows weak signs of electricity. When the heat is a little greater than that of the hand, it destroys completely its electric power, and by cooling, the electric power is again revived. He plunged the same crystal into a vessel of quicksilver surrounded by ice. After remaining two hours in cold water, he took it out with a pair of tongs, and upon again rubbing it, it showed more electricity than it had done formerly. He also found some pieces of calcareous spar that did not possess this property. This circumstance will account for the failure of Mr Bergman in trying to repeat these experiments of Delaval.

Mr Benjamin Wilson made a number of experiments on electricity, which he published in 1750, in a treatise on that subject, and in several papers in the Philosophical Transactions. He was unfortunately one of those individuals who opposed, with such obstinacy, the use of pointed conductors for thunder-rods, and was the means of introducing into the Royal Society those animosities and dissensions so fatal to the character and interests of science. The electrical properties of the tourmalin had been lately announced in the Memoirs of the Academy of Berlin, by M. Epinus, who found that when this mineral was moderately warmed, it exhibited a plus electricity on one side, and a negative electricity on the other. The Duke de Noys, who wrote upon this subject, maintains, that the two sides are electrified plus, and one of them more strongly than the other. In this state of the subject, it was taken up by Mr Wilson, who made his experiments on a specimen belonging to Dr Heberden, which weighed about 120 grains. The general result of these experiments was, that the tourmalin suffers the electric fluid to pass through it only in one direction, having, as it were, two electrical poles; that there are three different methods of heating the tourmalin, which produce different electric appearances; that different degrees of heat give different phenomena; and that friction has the same effect upon it as upon glass. Mr Wilson found that a number of other crystallised minerals of a red and orange colour, and having the hardness of topaz, possessed the same electrical quality as the tourmalin. Dr Thomson, however, has remarked, that these must have been varieties of tourmalin, which the imperfect state of mineralogy did not enable Mr Wilson to recognize. Mr Wilson also found, that when two electrices are rubbed together, the one is always electrified positively and the other negatively, the harder of the two having generally acquired the positive electricity.

About this time a number of curious experiments were made by Mr Symmer, on the electricity of stockings of different kinds. His papers were published in the Philosophical Transactions for 1759, and relate to four subjects: 1. On the electricity of the human body; and the animal substances silk and wool. 2. On the electricity of black and white silk. 3. On electrical cohesion. 4. On two distinct powers in electricity. Mr Symmer had frequently observed, that, on pulling off his stockings in the evening, they emitted a cracking noise, and even gave sparks of fire in the dark. He immediately conjectured that these phenomena were electrical, and commenced a series of experiments on the subject. He found the electricity very powerful when a silk and worsted stocking were on one leg, and it was of no consequence which of them was uppermost. When the stockings are thus excited, they appear more or less inflated, discharge an electrical wind felt by the bare leg, attract or repel another stocking visibly, and by being touched, emit or receive electrical fire. The best way of taking off the stockings is to pull the hand between the leg and the stockings, and to push them off together. They must then be pulled asunder, and will exhibit signs of electricity. When two stockings were both of the same material, they produced no electricity, so that it was always necessary to have one of them black and the other white. Having worn a pair of black silk stockings on his leg for ten minutes, he found them so highly inflated when taken off, that each of them exhibited the entire shape of the leg, and rushed together at the distance of one foot and a half. All these effects are most powerful when the stockings are either new, or newly washed.
In order to perform these experiments with less trouble, Mr Symmer made his subsequent experiments by drawing the stockings through the hand. The following are the leading results: Black silk is highly susceptible of electricity, being excited almost instantaneously, and with very little friction. White silk is greatly inferior to it, exhibiting neither sparks, nor emitting a crackling noise, but affecting the electrometer very slightly. A black and a white silk stocking drawn through the hand together, exhibit no electricity till they are separated. Mr Symmer went so far as to charge the Leyden phial by means of excited stockings; and with four silk stockings he even kindled spirits of wine. The electrical cohesion between white and black silk stockings attracted Mr Symmer's particular notice. A weight of from one to twelve ounces was required to separate them. At another time they required 17 ounces, including the scale and the black stocking, which was 20 times the weight of the white stocking that supported them; the weight acting in a direction parallel to the cohering surfaces. When one of the stockings was turned inside out, and put within the other, the separation required six ounces, whereas 10 was sufficient when they were applied to one another externally. With stockings of a more substantial make, one of them being put within the other, without being turned inside out, the separating weight was nine pounds, wanting a few penny-weights, which is 55 times the weight of the supporting stocking. When the white was turned inside out, and put within the black, so that their interior or rough sides were together, the separating weight was no less than 15 lbs. 1¼ dwt. which is 92 times the weight of the supporting stocking. When the application of the stockings was merely external, as before, they lifted only 1¼ of a pound, or 10 or 11 times the weight of the whole stocking. Mr Symmer found likewise, that excited stockings adhered also to unelcrtificd bodies, with broad and polished surfaces. Having thrown a stocking accidentally out of his hands, he was astonished to find it, some time afterwards, sticking to the paper hangings of the apartment. They adhered also to the painted boards of the room, and to the looking glass, and often remained suspended for a whole hour upon the hangings.

Mr Symmer concludes, from his experiments, that there are two distinct electri aide: that electricity is in the possession of a larger portion of one or the other power, as is necessary to maintain an even balance with the body; and that the electricity is negative or positive, according as the one or other power prevails.

Signior Alessandro Amadeo Vanudonia, who constantly wore a beaver shirt between two others, in cold weather, found that the upper shirt always adhered to the beaver shirt when it was taken off, and emitted electric sparks. This experiment was repeated by his friend Beccaria.

The experiments of Mr Symmer attracted the notice of M. Cigna, who published an account of several interesting results, in the Memoirs of the Academy of Turin for 1765. Having extended two dry white or black silk ribbons above each other, upon any smooth plain surface, he drew over them the sharp edge of an ivory ruler. Both the ribbons adhered to the plain, and when taken from it together they attracted each other, the upper one having been electrified positively, and the lower one negatively. When they were lifted separately, they repelled one another, having both acquired the negative electricity. In removing both the ribbons from the plain, and in their subsequent separation, electric sparks were always visible between them. If the ribbons, after having acquired, by the preceding operation, the same electricity, were placed upon any rough conducting body, such as cotton or hemp, not very dry, they exhibited, on separation, two contrary electrifications, which disappeared upon joining them together. When the two ribbons were rubbed upon that rough surface, they always were electrified in an opposite manner, the upper one having the negative electricity. The effect of a rough surface was produced by a pointed conductor. When the two ribbons, hanging parallel, and repelling each other, had the point of a needle drawn opposite to one of them, along its whole length, they instantly rushed together, the ribbon nearest the needle having its electricity changed. An unelcrtificd ribbon acquired electricity by placing it upon a rough surface, and having an electrified ribbon above it, or by holding it parallel to an electrified ribbon, and drawing a pointed conductor opposite to it, as before. If the ribs were rubbed with any skin, or a piece of smooth glass, in place of the ivory ruler, the same results were obtained; but when a stick of sulphur was employed, the electrivities were always the reverse of what they were before, the rubbed ribbon being always negative. If one of the ribbons was black and the other white, the excitation of the two was the uppermost, and in whatever way they were rubbed, the white one was generally positive, and the black one negative. Whenever the upper piece of silk, however, was loose, yielding, and like a net, or of the same structure as a stocking, so that it could be rubbed against the lower one, and whenever the rubber was of such a nature as to impart but little electricity to glass; under these circumstances, the electricity imparted to the upper piece of silk did not depend upon the rubber, but upon the surface which supported it, the black being always negative, and the white positive. When the structure of the silk was hard, stiff, and close, and when the rubber had the character of communicating much electricity to glass, then the upper piece of silk derived the character of its electricity from the rubber, and not from the supporting surface.

In another set of experiments, he brought an electrified ribbon near an insulated plate of lead, and observed a feeble attraction. When his finger was brought to the lead, a spark was emitted, after which the ribbon was vigorously attracted, and both together exhibited no marks of being electrified. Upon taking away the ribbon, appearances of electricity were exhibited in both, and a spark was seen between the plate and the finger. When two glass plates were placed upon a smooth conducting body, communicating with the ground, and excited in the same manner as the ribbons, they likewise acquired electricity, and stuck firmly both to the conductor and to one another. When the conductor was a plate of lead, not very thick, it was supported by the attraction. No signs of electricity were exhibited when they were all together. Upon removing from the conductor the two plates of glass together, their electricity was positive on both sides, while the conductor, if it had been insulated, seemed to be negatively electrified. When the two plates of glass were separated, the upper one was positively electrified, and the lower one negatively. With a rough conductor they scarcely contracted any electricity, though,
upon separation, they were electrified as before. Hence he endeavours to explain the nonexcitation of a globe or tube, from which the air is exhausted.

The celebrated chemist, Torbern Bergman, of Upsal, made a few experiments on electricity. He found, what had already been discovered by Boccara, that a small quantity of water was not capable of conducting the electric fluid, but that more was transmitted as the quantity of water was increased. He obtained a similar result from ice, and concluded that ice is a worse conductor than water. It was ascertained by later experiments, that ice became a non-conductor when cooled down to 13° of Fahrenheit.

To Mr Kinnesley, the friend and associate of Dr Franklin, electricity owes considerable obligations. Mr Kinnesley first distinguished himself by discovering the two opposite electricities of glass and sulphur, in which, however, he had been anticipated by Dufay; but he immediately saw that Dufay did not imagine that these two electricities were the same as the positive and negative electricities of Dr Franklin. He found that a coated flask, containing boiling water, could not be charged, as the electricity passed off with the steam; but as soon as the water was cold, the flask was readily charged. He found, that if a person insulated, and negatively electrified, should hold out in the dark a long sharp needle, pointing upwards, a light would be observed on the point of it, the electricity being in this case drawn from the air. Upon sending the charge of a case of 35 bottles through a piece of brass wire about 24 inches long, with a pound weight at the lower end, the whole wire became red hot, and was an inch longer than before. By means of a second charge, the wire was melted. It was drawn asunder near the middle, and when the two ends were put together, it measured four inches longer than before. *

M. Jalla-ber.

One of the most successful cultivators of the science of electricity was Mr Wilke of B-stock, in Lower Saxony, who has published an account of his labours in his celebrated work, entitled Disputatio Physica experimentalis de Electricitatis, Rostock, 1757, 4to. His researches respecting spontaneous electricity, a name which he gives to the electricity produced by the melting of electric substances, have contributed most essentially to the progress of the science. He found, that sulphur melted in an earthen vessel, which he placed upon conductors, was strongly electrical when taken out after it was cold, but it exhibited no indications of electricity when it was cooled upon electric substances. When melted in vessels of glass, the sulphur acquired a strong electricity, whether the vessels were placed upon glass vessels or not; but it was always stronger when they were not placed on electrics, and strongest of all when the glass vessel had a metallic coating. The electricity of the glass was, in these cases, constantly positive, and that of the sulphur negative; and, what was very singular, the electricity of the sulphur did not develop itself till it began to cool and contract, and reached its maximum at the point of greatest contraction. The electricity of the glass was then the least, and was strongest of all when the sulphur was shaken out of it, before its contraction commenced. Melted sealing-wax he also found to acquire negative electricity when poured into glass, and positive electricity when poured into sulphur. Sealing-wax poured into baked wood was negative, and the wood positive. Sulphur poured into wood became negative, but when poured into sulphur, or rough glass, it acquired no electricity. Mr Wilke's experiments on the friction of bodies are also interesting. When sulphur and glass were rubbed together, the glass was strongly positive, and the sulphur strongly negative. Wood excited with cloth was always negative. Wood rubbed against smooth glass is negative, but positive when rubbed against rough glass. Sulphur exhibited positive electricity only in the case when it was rubbed against metals. Lead, however, formed an exception; for sulphur became negative when rubbed against it, and the metal itself positive; from which Wilke concludes, that lead is not such a good conductor as the other metals. In the following catalogue given by Mr Wilke, the substances are arranged in the order in which they are disposed to acquire positive or negative electricity, any one of the bodies acquiring positive electricity when rubbed by any that follow it in the catalogue, and a negative electricity when rubbed with any that go before it:

|--------------|--------|-------|--------------|-------------|----------|--------|------------|--------|-------|-------------|

Mr Wilke believed, that smooth glass gives in all cases a positive electricity; but Mr Canton had discovered that the smoothest glass may be negatively electrified when drawn over the back of a cat.

The experiments of Dr Franklin and Mr Canton on electric atmospheres, were verified and extended by Mr Wilke, who concluded, that parts of non-electrics immersed in electric atmospheres acquire an opposite electricity to that of the atmosphere itself. The subject of electric light received also considerable illustration from the labours of this ingenious electrician. When two pieces of glass were rubbed together, he noticed a vivid phosphoreal light, which threw out rays, but adhered to the place where it was produced, and emitted a strong phosphoreal smell. As it was accompanied with no attraction or repulsion, he concluded that friction was not able of itself to produce electricity, but that it was necessary to have the bodies of different kinds; and he

* See Franklin's Letters, and Phil. Trans. 1763, vol. III. p. 84.
considered the production of phosphoreal light without attraction, as the excitation of electricity without the accumulation of it. When a tube was excited with a woolen cloth, with white wax or oil upon it, it ejected flames, each of which seemed to issue from a little fiery protuberance. He found, that when sparks were produced between two balls, (except when both the balls were metallic,) the light formed a cone, the base of which was always on the body positively electrified, and the vertex on the one negatively electrified,—a criterion which he considers as sufficient for discriminating the two elec-
tricities. When a point not electrified is opposed to a positively electrified point, the luminous cones, which in other circumstances would have been seen upon both of them, are not in this case visible; but if a positive cone be opposed to a negative cone, they both retain their characteristic properties.

We come now to lay before our readers an account of the labours of Epinus, who may be considered as the first person who employed geometry and analysis in extending the science of electricity. He performed a series of experiments similar to those of Mr. Wilke, on melted sulphur. When the sulphur was poured into metallic cups and cooled, the cup and the sulphur together showed no signs of electricity till they were separated, when the electricity was very strong; the electrical effects always disappearing when the sulphur was put back into the cup, and re-appearing when the separation was repeated. The electricity of the cup was always negative, and that of the sulphur positive; but if either of the two had been deprived of its electricity when they were separate, they both exhibited, when united, the electricity which had not been taken away, and which was always on the surface of the sulphur. Upon pressing together two plates of looking-glass, one of them exhibited after separation a strong negative, and the other a strong positive electricity. When they were again joined, the electricity of both disappeared; but if one of them had its electricity taken off when separate, then the two, when reunited, had the electricity of the other plate. He made the same experiments with glass and sulphur, with several other electrics, and with an electric and a piece of metal. Epinus and Wilke happening to be resident at the same time at Berlin, pursued in company their experiments on electric atmospheres, and were led to the discovery of a beautiful method of charging a plate of air, in the same manner as the charge had been communicated to plates of glass. Having found that the negative state of one of the bodies depended on the opposite state of the other, which was precisely the case with a charged pane of glass, they therefore tried to give an electric shock by means of air, which they effected, by suspending large wooden boards coated with tin, having their flat surfaces parallel, and some inches distant. When one of the boards was electrified positively, the other possessed a negative electricity, and when a person touched one of the plates with one hand, and the other plate with his other hand, he received a shock exactly as in the Leyden jar. The opposite electrics of the two boards occasioned a strong attraction, which it was necessary to counteract by means of strings, which prevented the approach of the boards. Sometimes the electricity of both the boards was discharged by a strong spark between them, in the same manner as when a pane of glass bursts with an overcharge. A shock was experienced when the discharge was effected by the intervention of the finger, and when there was any eminence on either of the plates, the spontaneous discharge always passed through it, and a pointed body fixed at this place, prevented the boards from being charged. Wilke and Epinus considered the two boards as representing the earth and the clouds electrified in an opposite manner, and the phenomenon of lightning as the bursting of the plate of air by a spontaneous discharge, which is always made through eminences. M. Epinus performed also some interesting experiments on the tourmalin, which he published in the Memoirs of the Academy of Berlin for 1756.

Notwithstanding the value of these experiments, the greatest service which Epinus did to electricity, was in connecting together all the scattered phenomena by an ingenious and plausible theory, of which he has given a full account in his Tentamen Theseei Electriatitus et Magnetismi; published at St Petersburg in 1759. This theory is founded on the following simple principles: 1. That the molecules of the electric fluid mutually repel each other, even at considerable distances, and with a force decreasing as the distance increases. 2. The particles of the electric fluid attract the particles of all known bodies, and are attracted by them in their turn, with a force following the same law. 3. The electric fluid exists in the pores of bodies, moving without any perceptible obstruction in non-electrics, such as the metals, water, &c. but with extreme difficulty in the pores of electrics, such as glass, rosin, &c. 4. The phenomena of electricity arise from two causes, 1st, From the transference of the fluid from a body containing more, to another containing less of it; and, 2d, From its attraction and repulsion, where no transference takes place. These simple principles are managed with great address, in explaining even the most singular phenomena of electricity, and enable us to predict, with the utmost exactness, the result of any proposed experiment.

The work of Epinus is, perhaps, too mathematical for ordinary readers, but it has been rendered accessible to those who have no mathematical knowledge, by the labours of the Abbé Hauy, in his work entitled Exposition raisonnée de la Theorie de l’Electricité et du Magnétisme après les Principes de M. Epinus. Paris, 1787, 8vo.

The labours of our countryman, Dr Priestley, were not confined to the composition of his labours on the history of electricity, which appeared in the year 1767, and which contains a full and instructive account of all the discoveries in electricity which had been made either in Europe or America. At the end of this work, he has given us an account of a number of original experiments, and he afterwards published several papers on electricity in the Transactions of the Royal Society. In attempting to ascertain the electrical qualities of mephitic air, Dr Priestley was led to make experiments on charcoal, as it was from that substance that he procured the gas in the greatest quantity. He found that charcoal, whatever was its state with regard to heat or cold, was nearly as good a conductor of electricity as the metals; a result which overturned the established notion, that all other bodies but water and the metals are non-conductors. Different pieces of wood charcoal had different degrees of conducting power; but the most per-
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Dr. Priestley observed a great variety in the electrical properties of different pieces of pit charcoal; but he had not ascertained the circumstances in the mode of preparing it, from which this variety was produced. Dr. Priestley likewise found that common coal cinders from an open fire were little inferior to charcoal in their conducting power. This discovery, says a celebrated chemist, "is a curious and unexpected analogy between the metals and charcoal; and chemistry furnishes us with several other no less striking and important. When the conducting power of charcoal was tried by succeeding electricians, it was found to vary in the most unaccustomed manner, sometimes scarcely conducting at all, sometimes imperfectly, and sometimes remarkably well. This diversity indicates a difference in the nature of different specimens of charcoal. Hence we may be assured that charcoal is a compound, and that it often varies in the proportion of some one or other of its ingredients." Dr. Priestley also found that there was a current of air from the points of bodies electrified plus or minus; that hot glass is a conductor; that electricity is easily diffused over the surfaces of new glass tubes, and therefore that the first coat of new glass is in some measure a conductor of electricity, but that after six or seven months these tubes lose this faculty, and are as easily excited as older tubes; and that the metallic tinge was much better communicated to the new than to the old glass, twice the quantity of metal being in all cases struck into it, a result which Dr. Priestley ascribes to the greater magnitude of its pores. Dr. Priestley found also that coloured circular spots are produced upon metallic plates, which receive an electrical shock from a strong battery. The most beautiful appearance of this kind, was one which he made upon a gold watchcase. The central spot was generally formed of shining dots, and the external circle consisted of cavities resembling those of the moon as they appear through a telescope; but in the spot upon the gold case there appeared, in several places of it, hollow bubbles of the metal. The cavities were deeper in some metals than in others, and he thought that the following was the order, beginning with those in which they were deepest, tin, lead, brass, gold, steel, iron, bismuth, zinc, copper, silver. Dr. Priestley likewise observed, that when an electrical battery is discharged, light bodies placed near the electrical circuit are put in motion, an effect which he ascribes to the sudden elasticity given to the air. He found that a long circuit conducts worse than a short circuit, even when the conductors are the same; and that when the circuit contains an imperfect conductor, a shock passes to bodies near, and yet no electricity is communicated.

The late Mr. Cavendish, whose genius has extended so many branches of physics, was likewise a successful cultivator of electricity. He conceived and executed the design of explaining all the phenomena of electricity by a simple theory, and his paper was actually drawn up and ready for the Royal Society, when he was made acquainted with the theory of Aepinus, of which, though published ten years before, he had never received the slightest notice. The theory of Cavendish may be considered as absolutely the same with that of Aepinus, though it is more accurate and more extended. "Since I wrote the following paper," says Mr. Cavendish, "I found that this way of accounting for the phenomena of electricity is not new. Aepinus, in his Tentamen Theoriae, &c. has made use of the same, or nearly of the same, hypothesis that I have; and the conclusions he draws from it agree nearly with mine, as far as he goes. However, as I have carried the theory much farther than he has done, and have considered the subject in a different, and, I flatter myself, in a more accurate manner, I hope the Society will not think this paper unworthy of their acceptance." In this paper, Mr. Cavendish lays down the hypothesis, and examines by as strict mathematical reasoning as the subject will admit, the various consequences that flow from the hypothesis, and then he compares it with the various experiments that have been made on the subject. Mr. Cavendish informs us, that he proposed soon to publish the results of some experiments in which he had been engaged for the purpose of trying the truth of his hypothesis, and of discovering the law of electric attraction and repulsion.

Notwithstanding the immense interval which elapsed between the publication of Aepinus' theory and the appearance of Mr. Cavendish's paper, yet no person can doubt that the latter is entitled to the credit of a second discoverer. Among his countrymen, at least, he is fully entitled to this honour; and if foreigners, who were less acquainted with the integrity of his character, should hesitate in conferring this secondary honour, we should at least have expected some acknowledgment of his labour, and some portion of praise for having improved and extended the theory of the Russian philosopher. We were therefore not a little surprised to find, that the name of Cavendish never once appears in the exposition of Aepinus' theory by the Abbe Hany, published sixteen years after the appearance of Cavendish's paper, nor in the extract from the Register of the Academy of Sciences, in which Laplace, Cousin, and Legendre, have given an account of the Abbe's work.

The extraordinary shocks given by the torpedo having been found by Mr. Walsh to be purely electrical, Mr. Cavendish began a series of experiments, with the view of obtaining an explanation of these singular effects. As the shock of the fish was given under water, and was incapable of being transmitted through water, of producing electric light, or of affecting an electrometer, the difficulty of obtaining a proper explanation seemed to be very great. He constructed an artificial torpedo made of wood, connected with glass tubes and wires, and covered with a piece of sheep's skin leather, and found in numerous experiments, that the effects of this apparatus agreed very well with those of the natural torpedo. See p. 476.

Mr. Cavendish likewise discovered, that iron wire conducts about 400,000,000 times better than rain or distilled water, or in other words, the electric fluid experiences no more resistance in passing through a piece of iron wire 400,000,000 inches long than through a column of water of the same diameter only one inch long. He also found that sea-water, or a solution of one part of salt in one of water, conducts 100 times better than fresh water, and a saturated solution of seawater 720 times better than fresh water. The former

* Dr. Thomson's History of the Royal Society, p. 44.
† See Phil. Trans. 1775, vol. 131: p. 461.
The science of electricity was now destined to receive the most brilliant accessions from the genius of M. Coulomb, to whom many of the physical sciences owe the deepest obligations. By means of an ingenious instrument invented by himself, called a torsion balance, Coulomb was enabled to measure small forces with a degree of accuracy hitherto unknown in physics. In order to avail himself of this contrivance, he investigated, both theoretically and experimentally, the laws of the force of torsion, (or the force with which a body untwists itself,) relative to the length, the thickness, and the nature of the metallic wires which he employed, and he has applied these laws with the utmost address, and in the most successful manner, to the most delicate researches in electricity, magnetism, and hydrodynamics. In the theories of Epicurus and Cavendish, the action of the electric fluid, in producing attraction or repulsion, was considered merely as diminishing with the distance; and in consequence of the law being undetermined, several problems received only an approximate solution. By the contrivance however already mentioned, of which we shall give a minute account in another part of this article, M. Coulomb discovered that the electrical force was, like that of gravity, in the inverse ratio of the squares of the distances; a conclusion the more interesting, as Newton and other natural philosophers had believed that the electrical and magnetic forces followed the inverse ratio of the cube, or even some higher power of the distance. The experiments from which this result was obtained, he varied in different ways, and always found them conformable to the preceding law; and in another memoir, he has explained different means by which he had obtained a similar result. The labours of Coulomb, however, were not confined to the determination of the law of electrical action; he found that the momentary dissipation into the air of moderate degrees of electricity, is proportional to the degree of electricity at the time; that the dissipation is not sensibly changed by any variation in the temperature or weight of the air; and that when the electricity was very weak, there was no perceptible difference in bodies of different kinds, or differing in shape or magnitude. The dissipation, however, was greatly affected by the hygrometrical state of the atmosphere, and was very nearly as the cube of the moisture of the air. M. Coulomb likewise examined the dissipation which took place along imperfect insulators, in which case the electricity seems to be conveyed along the surface of the insulator chiefly by the moisture which adheres to it, and obtained the following results: 1. The densities in different points of an imperfect insulator are in the subduplicate ratio of their distance from the point of complete insulation. 2. The lengths of canal requisite to insulate electricity of different densities, is in the duplicate ratio of the densities. And, 3. The length of canal necessary for insulation, is in the inverse ratio of the coercive or insulating force of the canal. M. Coulomb likewise found, that the most perfect of all insulators is a thread of gum lac, which, measuring its excellence by its shortness, insulates ten times better than a silk thread as dry as possible. When the silk thread was covered with fine sealing-wax, it had the same power of insulation as gum lac, when it was four times as long. The dissipation along these insulating bodies is not wholly owing to moisture, but to a small degree of conducting power.

The next object of M. Coulomb was to ascertain the distribution of the electric fluid in an overcharged body. He found, that if we bring an electrified conducting body into contact with another in its natural state, the electricity conveyed to the latter will depend solely on the shape of the two bodies, and in no respect upon the nature of the body itself; and that the fluid diffuses itself along the surface without penetrating the body. This result Coulomb at first obtained for bodies similar in form, and equal in surface; but he afterwards extended his enquiries to spherical bodies having surfaces of different magnitudes; and the general result was, that when the surfaces of the unequal spheres were as the numbers 1, 4, 16, 64, \(^{\infty}\), the density on the small globe was as the numbers 1, 1.08, 1.3, 1.65, 2, but never obtained the magnitude 2. The density of the fluid on different parts of the surface of two equal spheres in contact, he found to be as the numbers 0.1, 4, 5, 6, at the angles 6°, 90°, 60°, 90°, 180°, being almost uniform from 90° to 180°. M. Coulomb has likewise determined the mode in which the electric fluid is distributed among globes placed in a row, and between different points of the surface of a cylinder. In all his calculations, he has employed the hypothesis of the electric fluid being composed of two fluids, which are neutralized in the ordinary state of bodies, and disengaged when the body exhibits signs of electricity. The particles of each fluid mutually repel each other, and attract those of the other fluid. These two fluids have been called the fluid of \(\text{vitreus}\), and the fluid of \(\text{resinous}\) electricity.

There are few philosophers of the present day to discover whose electricity owes so much as M. Volta, professor of natural philosophy, at Como, in Italy. He invented an elegant instrument for collecting electricity, called an electrophorus, \(\dagger\) the first hint of which is said to have been given by Epicurus; and another instrument, called a condenser, the object of which is to accumulate and render visible the smallest quantities of natural or artificial electricity. The Galvanic discoveries of Volta have raised him to a high rank among the discoverers of the present day; and under the article \text{Galvanism} we shall have frequent occasion to follow him in his career of discovery.

In the year 1781, MM. La Place, Lavoisier, and Experiments of La Place and Lavoisier.

\(\dagger\) The name of electrophorus was given to this instrument from its retaining or carrying its electric virtue for a long time. See p. 515.

\(\dagger\) See Part 1, Chap. 1, Sect. 29, pp. 441, 480, 481.
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The general result of these experiments was, that the mutual repulsion of two spheres, electrified either positively or negatively, varied in \( \frac{1}{d^2} \), or was nearly as the inverse ratio of the square of the distance. When the experiment was made on the attractive force of balls oppositely electrified, the irregularities were greater than in the preceding case, amounting, in some instances, to \( \frac{1}{4} \)th of the whole force. The results, however, deviated rather less than the former, from the inverse duplicate ratio of the distances; but the deviation was in defect, as the other was in excess. From these results, Dr. Robison concluded, that the action between two spheres was like that of gravity, in the inverse ratio of the squares of the distances of their centres. It is much to be regretted, that Dr. Robison did not publish some account of these conclusions at the time when he obtained them. He would then have been entitled to a considerable share of that honour which has been bestowed on Coulomb. See page 440.

Towards the end of the 17th century, electricity was assiduously cultivated by a great number of eminent individuals, who extended the boundaries of the science by numerous experiments, and by the invention of ingenious and useful instruments.

By the aid of an admirable electrifying machine, and powerful batteries, M. Van Marum performed a series of interesting experiments on the fusion and the oxidation of metals by the electric shock. He obtained some curious results respecting the magnetic effects of electricity; and he made numerous experiments to ascertain the influence of the electric fluid upon animal and vegetable bodies.

The late Mr. Cavallo made many important additions to the science. His experiments with electrical kites, and thunder rods, added greatly to our knowledge of atmospheric electricity; and his instruments for measuring, doubling, condensing, and multiplying electricity, bespeak a mind full of ingenuity, and intimately acquainted with the science which he cultivated.

Mr. Nicholson made several curious experiments on the form of the electric spark, and on the excitation of electrical machines; and he enriched the science with two elegant instruments, which he called the spinning condenser, and the revolving doubler.

Electricity has derived new light from the labours of Hauy. That venerable philosopher M. Hauy, who has discovered, that the property of becoming electrical by heat, resides in mesityle, boracite, calamite, and prehnite, as well as in the tourmaline and the topaz. He found, that the boracite possessed eight electrical poles; and we owe to him the fine discovery, that the polarity which those minerals acquire from heat, is related to the secondary form of their crystals, those which have this property, deviating from that symmetry of form which is conspicuous in other minerals.

Mr. Cuthbertson had the great merit of giving a new degree of elegance and power to the electrical apparatus. His improvements on the plate glass machine; his mode of constructing and improving batteries; his new condenser, and his compound electrometer; entitle him to be considered as one of the most ingenious practical electricians of the present day. Along with Van Troschlywijk, he was the first that decomposed water by the electric shock; and he made many interesting experiments on the fusion and oxidation of metals by electricity.

Mr. Brooke was the first person who proposed the Brooke balance electrometer, and from numerous experiments
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on the fusion of metals by batteries, he was enabled to determine the law which was followed in the melting of metallic wires.

Bennet, Mr. Bennet, by his experiments, as well as by his invention of the gold leaf electrometer, and the doubler; Mr Read, by his experiments on atmospheric electricity; Mr Morgan, by his various researches; and Mr Henley, by his inventions and experiments, contributed greatly to the advancement of the science.

The conclusion of the 18th century was marked by an electrical discovery, which excited the most general attention. In 1790, M. Galvani, professor of anatomy at Bologna, discovered that muscular contraction could be excited in a frog recently killed, either by transmitting through the nerve a small quantity of artificial or atmospheric electricity, or by the mere contact of two different metals. This singular experiment was every where repeated and varied, and, during the discussions to which it gave rise, professor Volta of Como was led to the invention of the Voltaic or Galvanic battery; an instrument of enormous electrical power, which has led to the creation of a new science, and given rise to the most brilliant discoveries in chemistry. In our article Galvanism, we shall have occasion to give a full account of these splendid discoveries, and to review the labours of Volta, Sir H. Davy, Dr Wollaston, Biot, Thenard, Humboldt, Dr Robison, Dr Monro, Dr Henry, Dr Bostock, Messrs Nicholson and Carlisle, Mr Cruikshanks, Mr Sylvester, Mr Children, Mr Ritter, De Lue, Paafi, Van Marum, Simon, Wilkinson, Hisengen, Berzelius, Oersted, Erman and Brande.

The science of electricity seemed for a while to be completely abandoned, and the attention of philosophers wholly engrossed by the new science which had been established. The 19th century, however, commenced under circumstances very favourable to the science.

La Place.

The celebrated Count La Place, the Newton of the present age, investigated the manner in which electricity was distributed on the surface of ellipsoids of revolution. Coulomb had considered only the case of a conductor perfectly spherical; but La Place has shown, from an elegant application of the formulæ which he used in his researches on the figure of the earth, that the electricity will be distributed over the surfaces of all ellipsoids of revolution, and that the thickness of the coat of fluid at the pole will be to its thickness at the equator, as the equatorial to the polar diameter.

In this investigation, La Place was followed by M. Biot, a mathematician and natural philosopher of distinguished eminence, whose labours and discoveries we shall have frequent opportunities of reviewing in other parts of our work. He extended the results obtained by La Place to spheroids, differing but little from a sphere, whatever be the irregularity of their figure; and he found that the quantities of fluid carried off by discharging a glass plate by successive contacts, form a geometrical progression.

Our countryman Dr Wollaston had the merit of being the first who decomposed water by a simple current of sparks from an electrified conductor; and the arrangement by which this was effected, is marked by that ingenuity and beautiful simplicity which is characteristic of the labours of that eminent philosopher.

The science of electricity was now destined to receive the most brilliant ascensions from the application of the higher analysis. M. Poisson, a young mathematician of rare talents, and well known by his discoveries in the higher branches of astronomy, adopting the hypothesis of two fluids, has determined analytically the manner in which electricity is distributed on the surface of two spheres of different diameters placed in contact, and the results which he has obtained coincide wonderfully with the experiments of Coulomb. He then applies the analysis to the case where the two fluids occur at the same time upon the surface of the same body; and in the case of two spheres whose radii are as 1 to 3, and the distance of whose nearest surfaces is equal to the radius of the smaller sphere, he has computed tables, showing the distribution of electricity at the different points of the two spheres, and the kinds of electricity which they possess. These results also agree with the experiments of Coulomb, so far as he has carried them, and appear to furnish a confirmation of the theory of two fluids. The case of two spheres leads to equations with variable differences, and with two independent variables, which, M. Poisson observes, is the first time that an equation of this kind has presented itself in the solution of a physical problem.

In another part of the present article, we have given as full an account as we were able of the researches of this eminent mathematician; but we trust, that in some other part of our work we shall find an opportunity of again calling the attention of our readers to this interesting subject.


ELECTRICITY.

Part I. Descriptive Electricity.

Descriptive Electricity, is that branch of the science which describes all the various phenomena which are either produced, or supposed to be produced, by the same cause as the phenomena of excited amber. It naturally divides itself into three heads: I. The phenomena of electricity produced by friction; II. The phenomena of electricity produced without friction; and III. The effects of electricity, comprehending its mechanical, chemical, and magnetic effects, and its influence upon animal and vegetable bodies.

CHAP. I.

On the Phenomena of Electricity produced by Friction.

As friction is the mean which has almost always been employed for the production of electrical phenomena, and as the various discoveries which have been made respecting the communication, the distribution, and the dissipation of the electric matter, have been made by electricity excited in this manner, we shall introduce into the present Chapter an account of these important results, although they are equally deducible when the electricity has been either excited by heat, or obtained from any other source.

Sect. I. On the Production of Electricity by Friction.

If we rub a piece of amber with dry fur, or woollen cloth, and then hold the amber over any light substances, such as small pieces of paper, or the down of a feather, the light body will be attracted by the amber. The same effect will be produced, by rubbing the glass of a watch against the sleeve of the coat; and still more powerfully, by rubbing a glass tube with a piece of dry silk. In this latter case, when the tube is rubbed in the dark, sparks of brilliant light, accompanied with a crackling sound, will be emitted as long as the friction is continued. In like manner, if a dry black silk ribbon, about two feet long, be laid upon a white one of the same length, and be drawn over woollen cloth, or silk velvet, or even between the finger and the thumb, they will be found to adhere strongly to each other. When separated, they will attract one another, and rush together with considerable velocity. In a dark room, the separation of the ribbons will be accompanied with a flash of light; and any one of the ribbons, when separated from the other, will attract light substances like the amber and the glass already mentioned.

Now in these three simple experiments, the amber, the glass, and the silk ribbons have obviously received new properties, which they did not possess before they were rubbed, viz. the property of attracting light bodies, and the property of emitting light in the dark. These properties are called electrical. The amber, the glass, and the ribbons, are said to be excited by friction. The power of drawing to themselves light bodies, is called electrical attraction, to distinguish it from the attractions of cohesion, of gravity, and of magnetism. The light emitted in the dark, is named the electric spark, or electric light; and the body which is capable of acquiring these properties, is called an electric.

By rubbing a great number of other bodies with woollen cloth, fur, silk, &c. they are found to exhibit the same properties as amber and glass; while another class of bodies exhibit no such properties, with whatever substances, and in whatever manner, they are rubbed. Hence bodies are divided into two great classes, viz. electrics, or those which acquire by friction the faculty of exhibiting electrical properties; and non-electrics, or those which are incapable of acquiring electrical properties by friction. The following is a list of electrics arranged in the order of their perfection, those being regarded as the most perfect which produce the most powerful electricity by the least friction.

Table of Electrics.

Glass, and all vitrifications, even those of metallic substances.

The precious stones, such as diamonds, garnets, rubies, topazes, emeralds, sapphires, the most transparent of which are generally the most perfect.

Amber.

Sulphur.

Shell lac, and all resinous bodies, and resinous compounds.

Bituminous substances.

Silk.

Wax.

Cotton.

Dry animal substances, as feathers, wool, hair.

Dry paper, parchment, and leather.

White sugar.

Sugar candy.

The vapour of quicksilver.

Perfect Toricellian vacuum.

Ice of distilled water, at the temperature of — 13° of Fahrenheit.

Oil.

 Metallic oxides.

 Ashes of animal and vegetable substances.

 Dry vegetable substances.

 Hard stones, the hardest of which are the best electrics.
The substances in the above list which are marked in italics are evidently such as cannot be excited by friction; but they are inserted in the table, from their possessing, like the other electrics, another property, which we shall soon have occasion to notice. All bodies not contained in the preceding enumeration, cannot be considered as non-electrics. Those only are properly entitled to that name, which have been found incapable of electrical excitation. A list of them will be introduced with more propriety under another head.

**SECT. II. On Positive and Negative Electricity.**

In whatever manner, and by whatever bodies, electricity is produced, its general effects are always the same. Electric attraction, and electric light, are both produced, whether we make the experiment with excited glass, or excited amber. The electrics, however, generated from these two substances, have different characters, which manifest themselves by an attentive examination of their effects. If two small balls, turned from the pitch of elder, are suspended by silver wires, or fine threads, as is represented in Plate CCXLIII. Fig. 1, they will remain in contact. But as soon as a tube of glass, excited by friction, is presented to them, the balls diverge, and separate from each other, as in the figure. The same divergence is produced, by presenting excited amber or wax to the pith balls. But if, when the pith balls are in a state of divergence by the application of excited glass, we present also a stick of excited wax, the electricity will disappear, and the balls will collapse. If, on the contrary, when the divergence of the balls has been produced by the application of excited wax, we present to them a tube of excited glass, the balls will collapse as before. If the excited wax, and the excited glass tube, are presented together to the pith balls, no divergence will take place. Here then we have an unequivocal indication of two different kinds of electricity, viz. that of the glass and of the sealing-wax, the one always counteracting the effect of the other. These two kinds of electricity were denominated the _vitreous_ and the _resinous_ electrics, from the bodies by which they were produced; but as it has since been found, that resinous electricity can be obtained by the excitation of glass, and vitreous electricity from the excitation of resinous bodies, the terms vitreous and resinous can no longer be admitted. The terms _positive_ and _negative_, or _plus_ and _minus_, have therefore been universally employed to denote the vitreous and resinous electrics.

The substitution of these new terms will appear still more appropriate, when we consider that, in every case, where a body is excited, both positive and negative electricity are simultaneously produced, and in almost every case can be rendered visible by the application of the pith balls. This truth admits of a very simple proof, by exciting sealing-wax with dry flannel, and applying them together and separately to the pith balls. When they are applied separately, the flannel will indicate a positive electricity, like a tube of glass excited with silk, while the wax will indicate negative electricity. When they are presented together to the pith balls, no effect whatever will take place, so that the positive electricity of the flannel is in equilibrium with, or equal in effect to, the negative electricity of the wax. In the same manner, when the black ribbon is separated from the white ribbon, after being excited in the manner already described, the black will be found negatively, and the white ribbon positively electrified.

But the positive and negative electrics are not only simultaneous phenomena;—any electric can be made to exhibit either of the electrics, according to the nature of the substance with which it is excited, or the state of the surface of the electric itself. This important discovery we owe to Mr Canton, who established it by numerous experiments. Polished glass, for example, is positively electrified when rubbed with flannel, but negatively electrified when rubbed with the back of a cat; while rough glass acquires positive electricity by the friction of dry oiled silk, and negative electricity by the friction of flannel.

The results of the numerous experiments which have been made on this subject, are contained in the following Table, altered and greatly enlarged from the Table drawn up by the late Mr Cavallo, from the experiments of various electricians.

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* De Luc found, that when glass and caoutchouc were rubbed together, the electricity was on some days positive, and on other days negative. See *Nicholson's Journal*, vol. xxviii. p. 11.

† The effect of wax and resinous bodies is here given on the authority of Libes. Cavallo states, that they communicate negative electricity to rough glass.
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In the repetition of some of the preceding experiments, the minutest attention must be paid to the state of the bodies which are rubbed together, and to the manner in which the friction is applied. When a stick of sealing wax is rubbed with an iron chain, the electricity of the wax will be positive when its own surface is scratched, and negative when it is smooth. When a silk ribbon is drawn lengthwise over a part of another ribbon of the same length, the ribbon which has been rubbed along its whole length becomes positively and the other negatively electrified. In like manner, when the whole length of the bow of a violin is drawn over a limited part of the string, the hairs of the bow exhibit a positive, and the string a negative electricity, the body whose excited portion is of the least extent being generally negatively electrified. Some other examples of a similar kind have been given in our historical account of the experiments of Cigna.

In exciting metals with woollen cloth, similar anomalies have been observed by Haüy: the same piece of metal, even when placed in similar circumstances, sometimes acquiring positive and sometimes negative electricity. M. De Luc has observed a similar irregularity in the friction of glass and caoutchouc. This anomaly, however, is seen in a most beautiful manner in the mineral commonly called cyanite, which was first described by the younger Saussure, under the name of apparc. Some of the crystals of this mineral acquire positive electricity by friction, while others acquire negative electricity; and in some of them the one species of electricity is found on one face, and the opposite species on the other face, although neither the eye nor the touch could discover any difference either in the lustre or the polish of the two faces. From this property Haüy has called the mineral diathene, which signifies having two virtues.

The effect of minute circumstances in the simultaneous production of positive and negative electricity, is excellently illustrated by the experiments of Mr Cavallo, on the electricity of glass tubes containing mercury, and hermetically sealed. These tubes were about 31 inches long, less than half an inch in diameter, and half an inch thick. Having put about three-fourths of an ounce of mercury into the tube, he boiled it, and, when the air was rarefied, the tube was hermetically sealed. After cleaning and warming the tube, he brought it into a horizontal position, and excited it by the friction of the mercury, which took place in elevating and depressing either end alternately. When the tube after this kind of excitation was brought into a vertical position, the end containing the mercury was electrified positively, and all the rest of the tube negatively. When the positive end was raised, the mercury flowed to the negative end, but the end where the mercury now stood acquired a positive electricity, and the rest of the tube a negative one. When the positive end where the mercury first stood, was elevated without touching it with the hand, it exhibited only a very slight degree of negative electricity; and if the mercury was made to flow back to it, and again retire from it, its electricity was positive, while by elevating it with the finger it always became strongly negative.

Sect. III. On the Communication of Electricity.

In the few simple experiments of which we have given an account, the reader must already have seen, munition that electricity is capable of being communicated to other bodies. The pith balls obviously diverge, in consequence of the electricity which they receive from the excited glass or resin, and retain it for a considerable time. If we touch any of the pith balls, when in a state of divergence, with a piece of glass free from moisture, or with a dry stick of sealing-wax or sulphur, the di-
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The emergency will still continue. The electricity, therefore, possessed by the balls, is not capable of being carried off by passing through these bodies. Glass, sealing-wax, and sulphur, are hence called non-conductors of electricity, as they do not possess the power of transmitting the electric matter. If, on the contrary, we touch any of the pith balls with a piece of any metal, with the finger, or with any body containing moisture, the pith balls will instantly lose their electricity, and collapse. The electricity, consequently, which occasioned their divergence, has escaped, or been carried off by those bodies, and hence they have received the name of conductors. Between these two classes of substances, there are others which do transmit the electric fluid, but with less facility than those which are called conductors, and therefore they have been distinguished by the name of imperfect conductors. Substances called non-conductors, have also received the name of electrics, and sometimes insulators, from their having the property of insulating bodies, or forming a barrier, which prevents the communication of the electricity of the insulated body to those which surround it. The following Table contains all the substances which have the property of conducting electricity, arranged in the order of their conducting power. We have followed the order assigned to them by Mr Singer.

**List of Conductors.**

- All the metals.
- Charcoal well burnt.
- Plumbago.
- Concentrated acids.
- Charcoal in powder.
- Diluted acids.
- Saline fluids.
- Metallic ores.
- Animal fluids.
- Sea water.
- Spring water.
- River water.
- Ice above —13° of Fahrenheit.
- Snow.
- Living vegetables.
- Living animals.
- Flame.
- Smoke.
- Steam.
- Most saline substances.
- Rarefied air.
- Vapour of alcohol.
- Vapour of ether.
- Most earths.
- Most stones.

To these, we may add powdered glass and powdered sulphur, which have been found to be conductors by the experiments of Van Swinden.

**Remarks on the table.**

Several of the bodies in the preceding table lose their power of conducting electricity when they are made very dry, and therefore they owe their conducting power solely to the moisture, or the fluids which they contain: hence vegetables and living animals, for example, conduct electricity solely in virtue of the juices and fluids which they contain. The conducting power varies also with the temperature. Hot charcoal and hot water transmit electricity with more facility than when they are cold; and glass, which is a perfect non-conductor when cold and dry, becomes a tolerably good conductor when heated to redness; and the same change takes place upon resinous bodies when melted, and upon baked wood when heated. Air, however, does not conduct electricity, whatever be its temperature.

Although flame is here enumerated in the list of conductors, yet it has been shown by M. Erman, that the insulated flames of wax, oil, alcohol, and hydrogenc gas, only conduct positive electricity; while other substances, such as phosphorus, conduct only negative electricity. Mr Cuthbertson had observed, (Practical Electricity, p. 48.) that when the flame of a common candle was placed midway between two equal balls, one positively and the other negatively electrified, the flame was attracted to the negative ball, which became very hot, while the positive ball remained cold.

Mr Brande* has endeavoured to explain these phenomena in another manner. As some chemical bodies are naturally negative, and others positive, he supposes Mr Brande that the positive will be attracted by the negative ball, and the negative by the positive ball; and in order to ascertain the probability of this conjecture, he placed the flames of various bodies between two insulated brass balls, one of which was electrified positively, and the other negatively. By this apparatus he obtained the following very interesting results:

**Substances attracted to the Positive Ball.**

- Sulphurous acid vapour.
- A small flame of phosphuretted hydrogen slightly.†
- Fumes of white arsenic slightly.
- Large flame of carbonic oxide.
- Vapour of burnt sulphur.‡
- Flame of phosphorus.
- Vapour of phosphorus.
- Stream of muriatic acid.
- Stream of nitrous gas.
- Vapour of benzoic acid.

**Substances attracted to the Negative Ball.**

- Olefiant gas.
- Sulphuretted hydrogen slightly.
- Arsenicated hydrogen.
- Flame of hydrogen weakly.
- Sulphuret of carbon.
- Potassium in combustion, and its fumes.
- Flame of benzoin.
- Smoke of benzoin.
- Charcoal emitted by camphor in combustion.
- Resinous bodies exhibit the same phenomena as camphor.
- Amber exhibits the same phenomena as benzoin.

Dr Priestley found the conducting power of charcoal to vary very much in different pieces of that substance; and it has since been found, that this variation arises from, and is proportional to, the different degrees of heat that have been employed in making it.

The conducting property of ice was first discovered by M. Jallabert, and confirmed by Dr Priestley. M. Achard of Berlin, however, observed, in January 1776, that ice, at the temperature of 13° of Fahrenheit, lost

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*See Philosophical Transactions, 1814, Part I.
† A large flame of this substance was equally attracted by both balls.
‡ The direction of the flame could not be determined.
its conducting power, and became an electric. Above this temperature, the ice begins to conduct. This faculty increases with the temperature, and becomes very great near the boiling point. M. Achard employed, in his experiments, ice perfectly transparent, and free from air-bubbles. To obtain this, he poured distilled water into a vessel, and placed it, in frosty weather; on the window of a room tolerably warm, when compared with the external air. Hence the water froze on one side when it was fluid on the other; and the air, as it was extricated, passed into the fluid part, and thus left the ice perfectly transparent, and free from air-bubbles. He then formed the ice into a spheroid, and, by rubbing it when in motion about its axis, he was able to produce electricity in large quantities. The following Table contains a list of bodies that are non-conductors, arranged in the order of the resistance which they oppose to the passage of the electric fluid.

**List of Non-conductors.**

**Shell lac.**
**Amber.**
**Resins.**
**Sulphur.**
**Wax.**
**Jet.**
**Glass.**
**Vitrifications of all kinds.**
**Talc.**
**Diamond.**
**Transparent gems.**
**Raw silk.**
**Bleached silk.**
**Dyed silk.**
**Wool.**
**Hair.**
**Feathers.**
**Dry paper.**
**Parchment.**
**Leather.**
**Air.**
**All dry gases.**
**Baked wood.**
**Dry vegetable bodies.**
**Porcelain.**
**Dry marble.**
**Some siliceous stones.**
**Some argillaceous stones.**
**Camphor.**
**Caoutchouc.**
**Lyceopodium.**
**Native carbonate of barytes.**
**Dry chalk.**
**Lime.**
**Phosphorus.**
**Ice at 
\[\text{\degree} \text{Fahrenheit}.\]**
**Many transparent crystals when perfectly dry.**
**Ashes of animal bodies.**
**Ashes of vegetable bodies.**
**Oils, the heaviest being the best.**
**Dry metallic oxides.**

The remarkable property possessed by shell lac of transmitting the electric fluid with more difficulty than any other body, was discovered by M. Coulomb, and has already been noticed in our History of Electricity. When any of the substances in the preceding Table receive the least accession of moisture, their non-conducting power is diminished in proportion to the quantity of moisture which they have absorbed.

The slightest examination of the Table is sufficient to convince us, that there is no relation between any of the chemical and physical properties of the bodies which it contains, and their power of resisting the passage of the electric fluid. The early electricians imagined that metals and waters were the great conducting principles; but this property is obviously possessed by bodies which, so far as we know, contain neither of these ingredients.

In our History of Electricity, p. 416, we have already given some details respecting the length to which electricity has been conducted along metallic wires, and the rapidity of its motion. These details are sufficient to show, that no measurable interval of time elapses during the passage of the electric fluid along a space of four miles.

Mr. Singers, however, has expressed a doubt respecting the accuracy of these experiments. "They were made," says he, "at a very early period, and have not, I believe, been repeated since the improved state of the science has afforded the means of effecting such experiments with precision. Metals, although the most perfect conductors we have, oppose some resistance to the motion of electricity, and a charge will even prefer a short passage through air to a circuit of 20 or 30 feet through thin wire. It is therefore rather uncertain that the charge of a small phial has ever passed through an interval of four miles." Elements of Electricity, p. 142.

The subject of electric atmospheres belongs properly to the present Section. The term atmosphere is here employed to denote the space round any electrical body through which its electrical influence extends. Mr. Canton was the first electrician who examined this curious subject, and he found that all bodies immersed in the electric atmosphere of a positively electrified body, were negatively electrified; while those which were placed in the atmosphere of a negatively electrified body attained positive electricity. This may be proved by the very simple experiment of holding a pair of pith balls at some distance from an excited glass tube, and they will be found to diverge with negative electricity. In like manner, they will diverge with positive electricity when placed within the sphere of action of a stick of excited sealing-wax negatively electrified.

**Sect. IV. On Electrical Attraction and Repulsion.**

The attraction exhibited by electrified bodies was one of the first phenomena that was observed by philosophers; and we have already had occasion to notice an example of repulsion, in the divergency of two pith balls. These simple phenomena may be perceived with sufficient distinctness, by employing merely a tube of glass excited by a piece of silk; but, in order to exhibit the more interesting phenomena, of the approach and recession of light substances to an electrified body, we must be able to produce a higher degree of electricity than can be effected by a simple tube.

In order to obtain this, a cylinder of glass is mounted in a frame, so that it can be turned rapidly round its axis by means of a winch or handle. On one side of it is placed a small cushion covered with silk, against which the glass cylinder is rubbed during its rotary motion; and on the other side a brass or metal tube, resting upon a stand of glass, for the purpose of collect-
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The electricity generated during the excitation of the cylinder. This apparatus is called an Electrical Machine, and the metallic tube is called the Prime Conductor. Several of these machines, fitted up in various ways, are represented in one of our Plates, of which we shall afterwards give a very particular description; but it is enough for our present purpose to know, that a very high degree of electricity can be excited by the simple apparatus which has been mentioned.

Exp. 1. If, upon a tube of glass highly excited by a piece of silk, or by the human hand, we let fall any light substance, such as a piece of gold leaf or thin paper, the substance will be attracted to the tube, and then quickly repelled from it. If the tube is made to follow the body, it will still escape from it, till it meets with some other substance which is a conductor, and is not electrified. To this conductor it will impart all its electricity, and being again attracted by the tube, will experience another repulsion as before. This experiment was first made by Otto Guericke.

Exp. 2. Having electrified the prime conductor of the electrical machine by exciting the glass cylinder, bring near to the conductor a pitch ball, or a small feather suspended by a slender wire, the ball will be attracted by the conductor, and will continue to adhere to it till the electricity of the conductor is dissipated.

Exp. 3. If the ball or feather used in the preceding experiment is suspended by a silk thread instead of the metallic wire, it will at first be attracted by the conductor, and then immediately repelled, and will not return to it again till it has imparted its electricity to some conducting body.

Exp. 4. Take a number of threads, from 10 to 18, and about a foot long, and, having tied them together at both ends, suspend them by the upper knot to the conductor of the machine. As soon as the threads are electrified, the lower knot will rise, and they will swell out in the middle, and assume a spherical form. This experiment was first made by Mr. Wheeler.

Exp. 5. Suspend a metallic plate, or a wooden plate covered with tinfoil, either from the conductor of the machine, or from a separate stand connected by a chain with the conductor; and at the distance of three or four inches below a similar plate on a stand connected with the ground. Put some pieces of gold leaf or thin paper between these plates, and when the conductor is electrified, they will be attracted and repelled alternately by the two plates, and will continue their motion as long as the electricity remains in the conductor.

This experiment is rendered doubly interesting, by using small painted figures cut out of paper. These figures will dance upon the lower plate as if they were really animated, and will exhibit a number of attitudes of the most singular kind.

This experiment is excellently represented in Plate CCXLIII. Fig. 2, where every part of the apparatus is distinctly seen as to require no description.

Exp. 6. Place two small balls on separate glass pillars, three-fourths of an inch distant, so that the balls are insulated. Suspend by a silk thread a clapper, or small brass ball, so as to hang in the middle between the balls. One of the balls being made to communicate by a conducting substance with the conductor of the machine, and the other with the ground, the small ball of brass will oscillate between the two balls, striking them alternately, and producing an electrical chime.

This experiment is still more interesting, if we hang three balls upon a horizontal rod of brass communicating with the prime conductor. The two outermost balls must be suspended by metallic wires or strings, and the middle one by a silk thread, so as not to communicate with the rod, but to have a communication with the ground or table, by means of a chain going from the inside of the bell. A clapper or brass ball is suspended by silk strings upon the same horizontal rod, and between each of the two balls. As soon as the conductor is electrified, the brass balls will alternately be attracted and repelled by the adjacent balls, and by striking against them, they will produce a chime by no means disagreeable.

This experiment is distinctly represented in Fig. 3. Plate CCXLIII. A still more interesting variation of CCXLIII. The experiment is represented in Fig. 4, where a b is a rod of solid glass, supported upon a wooden stand, and passing through a perforated ball, No. 5. The other end of the glass rod supports two metallic arms crossing each other at right angles, having suspended at their extremities, by means of wires, four balls, 1, 2, 3, 4. From a point of each of these arms, equidistant from the extremity and the point of intersection, is suspended a brass ball by silk threads. Upon electrifying the conductor, all the five balls will set a ringing at the same time.

Exp. 7. Place upon the prime conductor a pointed wire, and by means of it electrify the inside of a very dry glass tumblers or jar. Place several pitch balls on the table, and cover them by the glass thus electrified. They will immediately begin to leap up and down against the sides of the vessel, and will thus be alternately attracted by it and the table for a considerable time.

Exp. 8. Suspend from the prime conductor a circular ring of brass or any other metal, about a foot in diameter, so that the ring is in a horizontal position. Place below the ring a circular plate of metal of a larger diameter than the ring, upon a stand like that represented in Fig. 2, so that it can be placed at different distances from the ring. Take a very small hollow ball of glass, blown extremely thin, and about two inches in diameter, and having brought the surface of the metallic plate to a distance from the ring less than its diameter, place the ball within the ring, and upon the plate, and as soon as the ring is electrified it will attract the ball, which will be animated at the same time with a rotary motion, and a circular motion of translation. If the experiment be made in the dark, the ball will appear luminous at all the points where it successively touches the ring.

Exp. 9. If the circular ring, in the preceding experiment, is insulated, and stands about an inch and a half from the flat surface of a table, and if a ball of glass, about two inches in diameter, is placed upon the table, and within the ring, it will first be attracted towards the ring, and after touching the ring and becoming electrified at the point of contact, this point will recede and be attracted by the table, while the ring attracts another part of the ball. Hence the ball will revolve about its axis, and move round the circumference of the ring.

Exp. 10. Fix a piece of sealing-wax at the end of a wire, and insert it into one of the holes of the prime conductor. When the sealing wax is softened by heat, turn the cylinder, and fine waxen fibres will be separated from the wax, and if received on a sheet of paper, will cover it with threads like red wool. By receiving it upon paper, and afterwards gently heating it, the result of the experiment will be rendered permanent.
The electrical effects which we have hitherto been considering, are of the most transitory kind, and exist only during the excitation of the electric. Although the electricity developed by the friction of a glass tube, or of a glass cylinder, was sufficiently strong for exhibiting many interesting experiments, and for the purpose of investigating the nature and properties of the electric fluid, yet it was not till the method of accumulating electricity was discovered, that philosophers became acquainted with the overpowering energy of this extraordinary agent.

This great step in the progress of the science was made by the celebrated Muschenbroek, in his invention of the Leyden phial or jar. This instrument is represented in Plate CCXLI. Fig. 5, where a b is a cylindrical glass vessel, having the lower part of its circumference covered with tinfoil all around, the inside being coated in a similar manner, and to nearly the same height. Through a perforation in the piece of wood or cork which forms the mouth of the jar, is inserted a brass rod d e, having a small ball of brass d at one end, and two or three inches above the top, and communicating by its other end with the inside coating, by means of a chain or wire. If the jar thus constructed is held to the conductor of an electrifying machine, so that the knob d may be about half an inch from it, a number of sparks will pass from the conductor to the knob d, and after growing weaker and weaker, they will at last cease. The electricity from the conductor has now been accumulated in the jar, and the jar is said to be charged. If any person now holds the jar in one hand by the outside coating, while with the other he touches the knob d, he will hear a sharp sound, accompanied with a brilliant flash of light, and will experience a severe and most disagreeable concussion in his wrists, elbows, and breast, the accumulated electricity of the jar having passed through his body. This sensation is called the electric shock, and the jar is said to be discharged.

The electric shock may also be experienced by any number of individuals, provided they take one another by the hand, and form the line of communication between the inside and outside coatings of the phial. If the person at one end of the line touches the outside coating, then the shock will be felt by every individual that composes it, the instant that the person at the other extremity touches the knob of the phial. In this manner the Abbé Nollet electrified 180 of the French guards in the king's presence; and, at the Carthusian convent in Paris, the whole of the religious persons formed a line of 5400 feet by means of iron wires between every two persons, and were all simultaneously electrified upon the discharge of the phial.

In order to discharge the jar without receiving a discharging shock, it is necessary to have two circular wires f m, g n; rod. (Fig. 6), having knobs f, g, at each end, and connected by a joint at m, where a glass handle, mn, is inserted. The experimenter takes hold of the glass part, and placing the lower knob g on the external coating, the discharge is effected as soon as the other knob f comes in contact with a. This instrument is called a discharging rod, and is represented in Fig. 5, in the act of discharging the jar.

The cylindrical form of the jar is by no means necessary to the accumulation of the electric fluid. The same effect is obtained when a plate of glass is coated on both sides with tinfoil, the glass extending about two inches beyond the metal all around, as is represented in Fig. 7. With this plate of glass, the same quantity of electricity will be accumulated as in a cylindrical jar, having the same area of coated surface.

When it is required to accumulate great quantities of electrical electricity, several of the cylindrical jars are placed in a battery with a box containing as many compartments as there are jars. The bottom of this box, upon which the jars must rest, is either covered with tinfoil or a treillis of wire, so that the outside coatings of the jars will communicate with one another by means of this metallic surface. The inside coatings are made to communicate with each other by horizontal bars of metal passing through the knobs of each jar; a construction which is represented in Fig. 8, which is a battery composed of 16 jars. Sometimes the wires from the inside coating, instead of terminating in a knob, are bent at top, and inserted in one common central knob. This form is shown in Fig. 9, which represents a battery of nine jars.

A battery may also be constructed by a combination of panes of glass coated as in Fig. 7. Dr Franklin formed a battery of this kind with 11 panes of common window-glass, and with it he made the greater part of his experiments.

Batteries of great size have been constructed by different electricians, so as to accumulate an enormous quantity of electricity, capable of melting the hardest metals, and of putting an instantaneous termination to the functions of animal life. Dr Priestley constructed a battery consisting of 64 jars, and containing 32 square feet of coated surface. Mr Cuthbertson completed, in 1784, for the Teylerian Museum at Haarlem, a battery of 135 jars and 132 feet of coated surface; and in 1789 he completed another battery for the same Institution, consisting of 100 jars, and containing 550 feet of coated surface.

Batteries are charged and discharged exactly in the same manner as a single jar. If one of the knobs of the battery communicates with the prime conductor of the machine in a state of action, it will soon be filled with the electric fluid; and the discharge may be effected by making a communication between the external and internal coating, by means of a discharging rod, or any other conductor.
The mode of constructing batteries, and the precautions which are necessary in using them, will be fully detailed in the practical part of this article. It is enough to know, at present, that, by such combinations, electricity is capable of any degree of accumulation.

**Sect. VI. Phenomena of the Leyden Phial.**

In the preceding Section we have already had occasion to mention the general construction and use of the Leyden phial as a means of accumulating the electric fluid. It presents, however, many phenomena of a very curious and instructive kind.

It is obvious, that the external coating of the Leyden phial has no communication whatever either with the internal coating or with the conductor of the electrostatic machine, and yet there is a manifest accumulation of electricity on the outside of the glass, or in the metallic coating which covers it. It becomes, therefore, an interesting inquiry, to discover in what way the electricity is communicated to the outside of the jar, whether the electricity is one side of the glass or in the coating, —what is the character of the internal and external electricities,—and in what manner they stand related to each other.

Dr Franklin, to whom we are indebted for almost every thing that has been done respecting the Leyden phial, began his experiments by examining the internal and external electricities of the jar. Having suspended a cork ball by a silken thread, he found that it was attracted by the outside coating while it was repelled by the inside coating; and that it was repelled by the outside when it was attracted by the inside coating. Hence it followed, that the inside of the phial always possessed an opposite electricity to the outside, the one being electrified positively when the other was electrified negatively. This important conclusion was still better established, when Dr Franklin observed that he could charge a Leyden phial by holding it by the brass knob, and presenting the external coating to the prime conductor. When the phial was charged in this way, the electricity of the external coating was positive, and that of the internal coating negative; and when the phial was charged in the usual way by the knobs, the internal coating was positive, and the external coating negative.

When two phials were both charged through their knobs, a cork ball suspended between them by a silken thread, was first attracted and then repelled by both the knobs as they were positively electrified. When both the phials were charged through their outside coatings, the ball was also repelled by them both; but when one of the phials was charged by its knob, and the other by its outside coating, the suspended cork ball played vigorously between them both, till the jars were nearly discharged. Hence it follows, that the one side of the phial possesses always the opposite electricity to the other, and that the two sides are simultaneously electrified, whether the electricity is drawn from the prime conductor by the one side or the other.

As glass is impenetrable to the electric fluid, it necessarily followed that the electricity was not communicated from the one side of the glass to the other; and this was easily ascertained by observing, that when the jar was insulated it was not capable of being charged but in a very trifling degree. Hence it followed, that the electricity of the outside of the jar was supplied from the earth by the conducting bodies which surrounded it, and that whenever one side of an electric receives one kind of electricity, the opposite side is simultaneously supplied with the opposite electricity, either from the earth or other conducting bodies which are near it.

The next object of Dr Franklin was, to ascertain if the positive electricity of one side of the phial was equal to the negative electricity of the other. For this purpose he hung a small linen thread near the outside coating of a charged phial, and every time that he presented his finger to the wire, the thread was attracted by the coating; the electricity taken from the inside by touching the wire being exactly equal to what was drawn in on the outside by the thread. Professor Richman obtained the same result by a very elegant experiment. Having coated both surfaces of a pane of glass within two inches of its edge, he fixed linen threads to the upper part of the coating on both sides. When the plate was not charged, the linen threads hung down in contact with the coating; but when the plate was placed in a vertical position and then charged, the threads were repelled from the coating, and formed equal angles with it on both sides. When his finger was conducted near the thread on the same side formed a less angle with the coating, while the thread on the opposite side formed an angle as much greater. Upon bringing his finger in contact with one of the sides, the corresponding thread fell down upon the coating, while the opposite thread formed twice the angle with the coating which it had done before. The angle formed by the two threads with each other was therefore always a constant quantity.

Dr Franklin at first imagined that the electricity accumulated in the jar existed in the coatings in contact with the glass, but he soon found upon further examination, that the electricity was contained in the glass itself, and that the sole use of the coating was, in the act of charging the jar, to conduct the electricity to all the parts of the glass which was in contact, and in the act of discharging it, to facilitate the communication between the two sides of the glass. In order to ascertain these points, he charged a jar, and placed it upon glass, or any insulating stand. He then took out the cork and the wire, and ascertained that they did not contain any electricity, by touching the outside coating with one hand, and putting the finger of the other hand into the mouth of the bottle, when he received a shock as powerful as if the wire and cork had been in their place. Having put water into the phial, which being a conductor, has always the same effect as a tinfoil coating, he charged the jar, and then pouring the water into an insulated bottle, found that it also would not give the shock. It then struck him, that the electricity must either have gone off in the act of pouring out the water, or must still be resident in the bottle. He therefore filled the phial with fresh water, and without any new charge he received the shock as before, which completely proved that the electricity resided in the glass. Dr Franklin made similar experiments with coated panes of glass, and obtained the same result, by changing the coating as he had charged the water. The same truth may perhaps be more satisfactorily established by the following experiment. Fix the outside coating of an uncoated jar with a little grease; and, instead of the inside coating, substitute a quantity of mercury, or of small shot, or gold leaf, or brass filings. As soon as it is charged, turn it upside down, so as to allow the mercury or shot to fall out along with the wire and knob, and remove also the outside coating. By this operation, the jar will not have
lost its charge; for if new mercury or shot be put into the inside, and a new piece of tinfoil on the outside, the shock will be felt as strongly as if no charge had taken place.

Dr Franklin likewise found, that when the glass was gilt, a part of the gilding was torn off, as if the electricity had passed from the glass through the gilding; and when a thin bottle was broken by the powerful attraction of the negative and positive electrics on each side, the glass was always broken inwards, while the gilding was broken outwards. The theory by which Dr Franklin explained these various phenomena, will be fully explained in the third Part of the article.

Other electric substances are capable of being charged in the manner as before; Boccelli indeed, on a charge being divided to a smooth plate of sealing-wax, made by pouring it in a fluid state upon an oiled marble table. He charged also a mixture of pitch and colophony, sulphur, and pitch, the magnitude of the charge being in the order in which these substances are named.

In our history of electricity, we have already given a sufficient account of the beautiful experiment in which Wilke and Epimius succeeded in charging a plate of air, and taking shocks from it as if it were a plate of glass.

We have already seen, that when a jar is discharged by the discharging rod, no effect is transmitted along the glass handle. When the handle, however, is made of brass, or any other metal, a small shock is transmitted to the person that holds it, when the quantity of electricity accumulated in the jar is considerable. In like manner, if a small chain is connected with the outside coating of a charged jar, it will appear luminous when the jar is discharged in the dark by any conducting circuit, of which this chain does not form a part. This effect has been named the lateral explosion, and may be shown most conspicuously by the following method, which was pointed out by Dr Priestley. Insulate a thick metallic rod, and place it with one of its ends contiguous to the external coating of a charged jar, and at the distance of half an inch from its other extremity place a large body about 6 or 7 feet long, and a few inches broad. Let a chain be now placed upon the table, at the distance of 14 inch from the outside coating, and apply one end of the discharging rod to the other extremity of the chain. As soon as the opposite extremity of the discharging rod is made to communicate with the knob of the jar, the discharge will take place, and a brilliant spark will be seen between the insulated metallic rod and the large body adjacent to it. This spark does not change the electrical state of the body; and it is therefore imagined, that this lateral spark flies from the coating of the jar, and returns to it before an electrometer can be affected. This lateral spark has the same length and brilliancy, whether it is received on flat or smooth surfaces, or on sharp points. In opposition to the result of the preceding experiment, Dr Robison informs us, that he has perceived a delicate electrometer affected by the lateral explosion.

**PLATE CCXLI.**

**Fig. 10.**

**Fig. 11.**

**Fig. 12.**

**Fig. 13.**

**Fig. 14.**

**Fig. 15.**

**Fig. 16.**

**SECT. VII. On the Electrical Spark, and Electrical Light.**

The light which always accompanies the excitation of an electric, was observed about the same time by Otto Guericke of Magdeburg, and our countryman Dr Wall, and attracted the particular attention of every subsequent electrician.

During the excitation of a glass tube in the dark, small flashes of light, accompanied with a crackling noise, are always observed; and in working an electrically charged machine, streams of blue light are constantly flashing over the surface of the glass cylinder. The electric light, however, is more distinctly observed when any round body is brought near the prime conductor of the machine. A brilliant light, called the electric spark, is seen between the body and the conductor, and exhibits a vast variety of appearances under different circumstances.

**Exp. 1.** If we hold a brass ball, about three inches in diameter, near the prime conductor of an electrical machine, sparks of bright white light will appear between them, attended with a loud snapping noise. When the ball is very near the conductor, the sparks appear in quick succession, and are quite straight.

**Exp. 2.** Having screwed a brass ball, about 2 inches in diameter, into the prime conductor positively electrified, so as to stand about three inches from it, hold another ball near the first, and long ramified or zigzag sparks will be obtained. This positive spark is represented in Fig. 10, where nat denotes the ball held in the hand, and in a natural state of electricity, while pos is the positive ball connected with the conductor. When the ball on the conductor is made very small, the spark becomes a faint divided brush of light.

**Exp. 3.** If the first ball in the preceding experiment is electrified negatively instead of positively, the spark becomes dense, straight, and more luminous than before. This is represented in Fig. 11.

**Exp. 4.** If one of the balls is positively and the other negatively electrified, the spark combines the appearance both of Figs. 10 and 11, as in Fig. 12. When the distance between the balls is not too great, the positive zigzag spark strikes the negative straight spark generally at the distance of one-third of the length of the latter from its point, the other two-thirds being rendered very bright. On some occasions, the positive spark strikes the negative ball at a distance from the negative spark.

**Exp. 5.** Take two conductors P, M, about three quarters of an inch in diameter, with spherical ends of the same diameter, and place them parallel to each other, so that their distance is about two inches, and their ends pointing in opposite directions, and six or eight inches asunder. These conductors are to be successively electrified. When P is positively electrified, it exhibits the ramified zigzag spark, and strikes the side of the other conductor M, as in Fig. 13. When M is negatively electrified, P being now connected with the earth, the sparks cease to strike as formerly; but the end of the electrified conductor M will exhibit the negative spark, and strike the side of P, as in Fig. 14. When one of the conductors is electrified positively, and the other negatively, the ramified or positive spark appears at one end, and the negative spark at the other, streams of electricity constantly passing between the ends of the conductors, as is shown in Fig. 15.

**Exp. 6.** Fix a fine point upon the extremity b of a stem b c, and upon this stem place a brass ball a, about six inches in diameter, in such a manner, that, by turning round the ball A, the point may be made either to withdraw itself within the surface of the ball, or protrude itself beyond it. The point will not act when it is beneath the surface of the ball, and the ramified spark will be seen between the two balls, as in Fig. 16; but in proportion as the point is protruded beyond the surface, it increases the transmitting power, and may be made to have the same effect as any ball whatever, from the smallest size to six inches in diameter. When it projects to a sufficient distance from the ball, it acts as
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If no ball were present. Mr Nicholson, to whom we are indebted for the preceding experiments, remarks, "that the effect of a positive surface appears to extend further than those of a negative one, for the point acts like a ball when considerably more prominent, if it be positive, than it will if negative."

Mr Nicholson has applied the preceding principle to the construction of a simple instrument for distinguishing positive from negative electricity, when they are sufficiently strong to afford sparks. Two metallic balls A, B, Fig. 17, may be placed at different distances, by means of a joint C. The arms CA, CB, are made of glass, and covered with varnish, and a short point p projects from the ball B towards the ball A. This simple apparatus is now to be placed near any electrified body, so that the electric power may pass through the balls; then if the electricity passes from A to B, there will be a certain distance of the balls, at which a spark will pass between them, and this distance will be much shorter when the electricity is passing from B to A.

Exp. 7. Hold an uninsulated sheet of paper near a positively electrified conductor, and the electrical light will form a beautiful star, about four inches in diameter, consisting of distinct radii, but not ramified. Perform the same experiment with a negatively electrified conductor, and instead of forming a star, it will throw out many pointed brushes of light to the paper.

Exp. 8. Present the point of a needle to a body positively electrified, in the dark, and the point will be illuminated with a star; but when the body is negatively electrified, it will exhibit a pencil or brush of light.

From the two preceding experiments, it becomes very easy to distinguish positive from negative electricity, by means of the different characters of the electric light.

Exp. 9. It appeared from experiment 6, that the effect of a point was destroyed, when it was withdrawn into a large brass ball, and sparks were produced as if the point had been wholly removed. The same effect will be obtained if the point is inclosed in a glass tube, or if it is placed between two balls.

Exp. 10. When sparks are passing between the conductors and a brass ball 14 inches distant, present a sharp point at double that distance, and the sparks will no longer appear.

The brilliancy of the electrical spark is proportional to the conducting power of the bodies between which it passes. Hence metals are used for the production of the electric spark. When an imperfect conductor, such as wood, is employed, the electric light appears in the form of faint red streams. The length of the spark depends upon the power of the electrical machine, and the state of the weather when the experiment is made. With a very powerful electrical machine sparks may sometimes be procured from 10 to 20 inches long, and these sparks always pass from the positive to the negative ball.

The electric spark always varies its character with the nature and density of the medium through which it is transmitted. The earliest experiment upon this subject was made by Dr Watson, on a large scale, and is one of the most beautiful which can be exhibited.

Exp. 1. Take a glass cylinder, three feet long and three inches in diameter, and fit it up at one end so as to be able to let down a brass plate from the top, in order to approach another brass plate fixed at the bottom of the cylinder. Let the cylinder be now exhausted and insulated. When the upper plate is electrified, the electric matter will pass from one plate to another, at the greatest distance at which the plates can be placed, and the lower plate will be electrified as if it had been connected with the prime conductor. When the room is dark, the electric matter, which in the open air passes in small brushes or pencils of light about an inch or two long, will now be transmitted in vivid coruscations of a bright silver hue along the whole length of the tube. These coruscations do not divide as in the open air, but from a base apparently flat, they frequently divide themselves into smaller and smaller ramifications, like the coruscations of the northern lights. When the vacuum is very perfect, the electric matter will pass between the plates in a continued stream of the same size throughout its whole length.

Exp. 2. Having placed the brass plates at the distance of 10 inches, make this vacuum a part of the circuit through which a jar is discharged, and at the instant of the discharge, a mass of bright embodied fire will be seen to leap from one of the brass plates in the tube to the other. When the distance of the plates is greater than 10 inches, the light begins to diverge and lose its force, and this diversity is nearly proportional to the distance of the plates.

Exp. 3. Form a Toricellian vacuum in the angular part of a long bent tube of glass filled with mercury and inverted, and place the legs of the bent tube in separate basins of mercury. If this vacuum is insulated, and one of the basons of mercury made to communicate with the conductor, while some non-electric substance touches the other, the electric light will pervade the vacuum in a continued arch of lambent flame, without the least diversification. If one of the basons be connected with the machine, which should be insulated, the light will pervade the vacuum in a contrary direction.

These three experiments were made by Dr Watson.

Exp. 3. Through the top of the receiver of an air-pump, a foot high and half a foot broad, insert a pointed wire, so as to project two inches into the inside, place the receiver on the plate of the air-pump, and connect the wire with the prime conductor of the electrifying machine. A brush of light will appear at the point of the wire; but as soon as the exhaustion of the receiver commences, this brush will enlarge itself, and vary its shape; and when the rarefaction is considerable, the whole of the receiver will be filled with a beautiful blush of light, the colour of which changes with the strength of the electricity.

Exp. 9. Into the extremity of a glass tube 30 inches, insert an iron wire projecting into the tube, and having a ball on the outer end of it. Fill the tube with mercury, and at the open end place a drop of ether, and secure it by the finger, while the tube is inverted so as to form a Toricellian vacuum in the upper part. The ether will rise to the top, and upon the removal of the finger, and the descent of the mercury, it will expand into vapour. If electricity is now transmitted through this vapour it will become luminous, and assume various hues according to its strength. If a strong spark passes through some inches of the vapour, the light is generally of a blue colour.

In condensed air and in carbonic acid gas, the light of the spark is white and brilliant, but in hydrogen gas it is red and faint.

Exp. 10. Charge a Leyden phial by its knob, and take away the knob by a stick of sealing wax. Place
the charged jar under the receiver of an air pump, and exhaust the receiver. The electric light will then flow out copiously from the neck of the bottle, and will divide itself into several jets, which will bend round in order to reach the internal surface of the jar. If the jar is charged by its external coating, and placed under the receiver as before, the electric light will throw itself in jets, from the external coating to the neck of the jar.

Exp. 11. Into a piece of soft deal, about three inches long, and 1½ inch square, insert obliquely two pointed wires, having their points 1½ inch distant, and penetrating to different depths below the surface, so that the line joining them is in the direction of the fibres. While the spark passes from the one wire to the other, it will exhibit different colours at different depths. If the one point is deeper than the other, all the colours will appear at once, as the electric light is transmitted at various depths.

When the sparks pass through balls of wood or ivory, they are of a crimson colour. They are green when taken from the surface of silvered leather, yellow when taken over powdered charcoal, and of a purple colour when taken from imperfect conductors. In the vapour of ether, the green sparks appear while the eye is placed close to the tube, and reddish when seen at a considerable distance.* The colour of the spark in very rare air is green, and in denser air it becomes blue, and then violet and purple, till the medium has become so dense as to be unable to conduct electricity.†

Upon rarefying the air 500 times within a glass jar, about one foot long and eight inches in diameter, Mr Smeaton placed the jar upon a lathe, and turned it round rapidly, whilst at the same time he rubbed it with his hand. A considerable quantity of lambent flame appeared under his hand, variegated with all the colours of the rainbow. The light was steady, but every part of it was constantly changing colours.

When metallic substances are completely continuous, and of sufficient size, they do not become luminous by the transmission of the electric light. The difficulty therefore of making bodies luminous by electricity, must increase with their conducting power. When there is any breach of continuity in the body, a spark will always appear at every separation; hence at each link of an electrified chain, a spark is distinctly visible, and, from a similar cause, perhaps, gold leaf may be rendered luminous. The appearance of light at the separation of the parts of a metallic body, is the foundation of several curious experiments, which we shall lay before our readers.

Exp. 12. Having connected one end of a chain with the outside coating of a charged phial; place the end of another piece of chain, coming from the knob of the jar, at the distance of a quarter of an inch from the former, and set a glass vessel full of water upon both these ends. When the jar is discharged, the water will appear completely luminous.

Exp. 13. A strip of gold leaf, about the eighth of an inch broad, and three feet long, will be rendered luminous throughout its whole extent, by the explosion of a jar containing two gallons. If the gold leaf is laid on glass, and below water, it will be still more brilliantly illuminated when the charge of a battery is passed through it.

Exp. 14. Attach one wire to the outside coating of a charged jar, and another to one of the branches of the discharging rod, and having placed their other ends at the distance of 1-10th of an inch, press the thumb upon the two ends. Bring the other branch of the discharging rod in contact with the knob of the jar, which being thus discharged, the spark will pass under the thumb, and illuminate it in such a manner that the bone and the principal blood vessels may be readily observed.

Exp. 15. Place a lump of sugar on the table, and in contact with the outer coating of a charged jar. Place one of the knobs of the discharging rod on the outside of the sugar, and bring the other to the knob of the jar. As the spark passes through the sugar it is rendered luminous, and retains the light for a considerable time.

Exp. 16. Paste upon a tube of glass a number of small round pieces of tinfoil, as in Fig. 18. The distance between each being about the 30th of an inch. When this tube is held near the prime conductor, a brilliant line of light will appear to surround it, a spark being visible between each of the small circles of tinfoil.

Exp. 17. Let several of those spiral tubes be placed on a board, as in Fig. 19, and round a central glass pillar supporting a wire ab, having a ball a and b at each extremity, and capable of turning round an axis. Communicate several sparks from a conductor to the ball C, and pushing the wire ab gently round, each tube will receive a spark from the balls, and will be illuminated as in the preceding experiment.

In like manner, luminous words may be made, as in Fig. 20, and a similar effect may be produced, by discharging a jar coated in the manner represented in Fig. 21, where there are on the outside five rows of square pieces of tinfoil, with eleven in each row, and the same number on the inside of the jar, making in all 110 square pieces. The diagonals of the square pieces are in a horizontal and a vertical position, and there is a round hole in the centre of each. Every adjacent pair on the outside, nine, have two of their square points meeting in the centre of the round hole in the intervening pieces of tinfoil on the inside, so that 110 sparks will be seen at once in a horizontal direction upon the discharge of the jar, and 110 sparks in a vertical direction.

It was imagined by some of the early electricians, that the electric light contained no prismatic colours. Light has the same optical properties as any other light.

Sect. VIII. On the Influence of Points in receiving and discharging Electricity.

In the section upon electric light, we have already seen the effect of obtuse bodies, such as balls, in carrying off the electricity of a conductor by a succession of brilliant sparks; and we had occasion to observe, that when a ball was thus receiving sparks, any pointed body placed...
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Exp. 1. Bring a metallic point near the prime conductor after it has been charged with electricity, and it will draw off the whole of its electricity without any noise, so that no spark will be received either by presenting the knuckle, or any metallic body. In the dark, there will be seen at the point a plume of light if the conductor be negatively electrified, and a simple point of light if it be positively electrified.

Exp. 2. Fix a metallic point in the prime conductor, and when it is electrified by the action of the machine, a hissing noise will be heard arising from the rapid discharge of the electricity from the pointed wire. By holding the hand near it, a strong blast of air will be felt as proceeding from the point, and in the dark it will emit a beautiful plume of light if the conductor is positively electrified, but will exhibit a luminous point if the conductor is negatively electrified. This current of air is so strong, as to be able to give a rotatory motion to pointed bodies balanced upon a pivot.

Exp. 3. If when the electricity is drawing rapidly off by means of a point, we present several points together, a spark will pass from the conductor to the points, so that the effect of one point is diminished by the presence of another, and when the points are numerous, they produce the same effects as a round body.

Exp. 4. If a man, insulated by standing upon a stool with glass feet, holds in his hand a rod, with a ball at one end and a point at the other, he will be able to electrify himself, so as to give sparks when he holds the point at a short distance from the prime conductor; but when he holds the round end at the same distance from the conductor, he will not be able to draw any electricity from the conductor.

Exp. 5. If a man, insulated as before, is electrified, the electricity will be rapidly discharged when he holds out any pointed body, and in the dark the light will be seen streaming from the point.

Exp. 6. If two cross wires ab, cd, Fig. 1, with a cap c at the point of intersection, and having 4 sharp points as a, b, c, d, turned in the same direction, be nicely balanced upon a point at the top of the insulated rod or stand ef, and if they are connected with an electrified conductor by the chain gh, they will immediately receive a rotatory motion. In the dark, a stream of light will issue from each point, and, from the velocity of rotation, these four streams will form a beautiful circle of light.

Exp. 7. Upon the preceding principle, an apparatus called the electrical orrery is constructed. If a globe S (Fig. 2) representing the sun, has a projecting arm SB, and if upon the pointed extremity of this arm is balanced another ball E, representing the earth carrying a wire M a, with a point a at one end, and at the other a ball representing the moon; then, if a point b is fixed in the middle of the arm SF, and if the whole is balanced on an insulated stand, by loading one side of the globe S, let the apparatus be connected by a chain gh, with the prime conductor of an electrical machine, and a rotatory motion will be given to both the arms, so that the moon M will move round the earth E, while the earth performs its revolution round the sun S.

Exp. 8. Insert five arms of wire, having their extremities pointed and turned in the same direction, into a piece of wood supported upon a point at the top of a glass pillar, as shown in Fig. 3. To one of these arms, which is longer than the rest, suspend a glass clapper by a silk thread, and behind it a rod cd. Let 8 bells be now placed upon the stand, and if a chain passes from the upper point a to the prime conductor, the points will move round, and the glass clapper will strike against the bells during its successive revolutions.

Exp. 9. Let an inclined plane be formed of two straight parallel wires, AB, CD, and insulated by four glass pillars, A, B, C, D fixed in a stand; and let a small wire, mn, with two little balls at its extremities, be made so as to slide down the parallel wires by the force of gravity. On a pivot in its centre, balance a wire ap with two points turned in the same direction. When the wire mn is near the lower end of the inclined plane, connect the parallel wire with an electrified conductor by means of a chain. The wire ap will immediately turn round the pivot upon mn, and will ascend the inclined plane.

The great utility of points as conductors or thunder rods for carrying off the electricity of the atmosphere, and the theory of their mode of action, will be fully explained in other parts of the present article. See Sect. XI. On the Distribution of Electricity, Art. 3, p. 455.

Sect. IX. On the Law of Electrical Attraction and Repulsion.

Sir Isaac Newton, and some other philosophers, had long ago imagined, that electrical and magnetic attraction followed the inverse ratio of the cube, or some higher power of the distance. Ampère and Cavendish, in their theories of electricity, have assumed no particular law, but merely that the action decreases as the distance increases, although the former had suspected that the law was the same as that of gravity.

Lord Stanhope had endeavoured to show, that electrical actions followed the inverse ratio of the square of the distance, and his reasons were by no means conclusive, and the law was still considered undetermined.

Our countryman Dr Robison, more than 40 years ago, made a variety of experiments on this important subject, and determined that the law of electric attraction and repulsion was nearly in the inverse duplicate ratio of the distance. An account of his experiments was read before a public society so early as 1760, but unfortunately he did not then regard them as of sufficient importance to be laid before the public. As we conceive that Dr Robison is entitled to a share of that honour, which is now given to Coulomb, we shall lay before our readers an account of the method by which he ascertained the law of electrical action.

The instrument with which Dr Robison’s experiments were made, is represented in Figs. 5 and 6. Fig. 6, being a perspective view of the whole instrument. A polished black ball A, ⅔ of an inch in diameter, is fixed on the point of a very slender needle three inches in length; the other extremity of the needle passes through a ball of amber or glass F, about three-fourths of an inch in diameter, but though the ball is completely perforated, the end of the needle must not extend quite to the surface. At right angles to the needle, a slender glass rod is fixed into the ball F; it is bent at right angles at
E, and is continued to L, exactly above the centre of the ball A. The length of this rod is six inches from F to L. At the extremity L is fixed a piece of amber C, with an opening in the middle to admit the rod DCB. The rod DB is formed of a silk thread coated with sealing-wax; the silk thread must be very strong and very dry, and, when completely penetrated by the melted wax, it must be made straight and smooth, so as to be sufficiently stiff and free of all asperities. This rod passes through a small cube of amber, which has fine holes drilled in two of its opposite sides; and by means of two round pins passing through the piece of amber C, the rod DB has a free motion round these pins as an axis. The branch CB of this rod is about three inches long, and carries at its extremity a ball B a quarter of an inch in diameter, which may be either made of metal, or of cork gilt and burnished. The other branch CD, which is of the same length, passes through a small cork ball. When the instrument is thus constructed, the lower ball B must just touch the ball A, when the arm FE is in a vertical position. The ball F, Fig. 5, must now be fixed at the extremity of a glass rod FI, which passes through a right angle through the centre of a divided circle GHO, and has a handle of boxwood at its other extremity I. This rod, which is perpendicular to AF, is supported by the head of a pillar IK, in which it turns with some difficulty. An index NH, fastened to the rod FI, is always set parallel to the line LA, drawn through the centre of the fixed ball. This index will point out the angle which LA forms with the vertical line. It will also be convenient to have another index, which turns stiffly on FI as an axis, and stretches a considerable way beyond the graduated circle. The graduated circle is divided into 360 degrees; the zero of the division is placed uppermost, and 90 on the right hand.

In order to use this instrument, take hold of the handle I, and set the index to 90. The lines LA and CB will now have a horizontal position, and the ball B will rest on A. Let the balls be now electrified, and let the index be brought back to 0 on the scale, by the handle I, during this motion the balls will be seen to separate in some particular position of the index; repeat this operation till the exact position is ascertained at which the separation takes place. This will shew the repulsive force when in contact, or at a distance equal to the sum of the radii. Let the instrument be now turned still more towards the vertical position, and the balls will be observed to separate more and more. An assistant must turn the long index, so as to make it parallel, by making the one appear to coincide with the other. In order to show that this instrument will give an absolute measure of the repulsive force of the two balls, we have only to balance the rod BD in a horizontal position by loading the ball D with some greater weight; then, by computing for the proportional lengths of BC and DC, we shall find the exact number of grains with which the balls must repel each other, in order merely to separate, when the rod BD has a horizontal position. When this rod has any oblique position, a very simple computation will give us the number of grains of repulsion, with which they will then separate; and a third computation, founded on the resolution of forces, will give us the repulsive force in grains, when A I has an oblique position, and when the rod BD forms any angle.

In order to make this instrument measure the attractions of two balls, one of which is positively and the other negatively electrified, we must incline the instrument to the left, and by electrifying the balls A, B, in an opposite manner, when at a great distance from each other, they will approach by their mutual attraction; and by means of the deviation of BC from a vertical line towards A, we shall be able to determine the magnitude of the attractive force. In making experiments with this instrument, the greatest care should be taken to provide as much as can be done against any dissipation or waste of the electric matter, by having all angles and asperities removed, by varnishing all its parts, and by making the experiments in a warm room, and when the atmosphere is particularly dry. Dr. Robison recommends, that the dissipation per minute, under various circumstances, should be determined by a previous set of experiments.

By means of different instruments of this kind, of different sizes, and of some of them of balls of an inch in diameter, and radii of 18 inches, Dr. Robison performed more than an hundred experiments, from which he concluded that the mutual repulsion of two spheres, electrified in the same manner, varied as \( \frac{1}{d^2} \), \( d \) representing the distance of their centres.

Several years after these experiments of Dr. Robison's were made, and read before a public society, the attention of Coulomb was drawn to the same topic, by the prize on the subject of the magnetic needle, which he had the good fortune to share with Van Swinden. His first object was to contrive an apparatus for measuring very small quantities of electricity. This apparatus, which he employed in all his experiments, and which he calls a torsion balance, is represented in Plate CCXLIV. Fig. 7, where ABCD is a glass cylinder, 12 inches high and 12 inches broad, on which is placed a plate of glass AC, 13 inches in diameter. This plate, which covers the whole of the cylinder, is pierced with two holes \( f, m \), both of which are 20 lines in diameter. Into the hole \( f \) is cemented a tube of glass \( fh \) two feet high, and at the upper end of the tube at \( h \) is placed a torsion micrometer, which is seen on an enlarged scale in Fig. 8.

The upper part of this micrometer consists of a button \( m \), an index \( i, o \), and a pair of pinsers \( g \). This upper part is let down into the hole \( G \), in the centre of the circle \( a, b \), which is divided upon its edge into 360 degrees. This plate is soldered upon a tube of copper \( N \), which enters into the tube \( H \), Fig. 9; and this tube is cemented into the upper extremity of the long glass tube \( f h \). The pinsers \( g \) have nearly the shape of the extremity of a solid port-crayon, which can be opened and shut by means of a ring \( r \). These pinsers lay hold of the extremity of a very slender silver wire, the other end of which is held at \( P \), Fig. 10, by the pinsers of an iron or copper cylinder \( P \), about a line in diameter. These pinsers, like the former, are opened and shut by a ring \( Q \).

This cylinder is perforated at \( C \), to receive the needle \( q \). The weight of this part of the apparatus must be sufficiently great to stretch the silver wire without breaking it. The needle \( a, g \), which must be suspended horizontally about six inches from the bottom of the glass cylinder ABCD, is formed of a silk thread, or a straw covered with sealing-wax, and has the part \( qa \), about 18 lines in length, formed of a cylinder of gum lac. At this extremity is a small ball \( a \) of the pith of elder, about two or three lines in diameter; and at the other extremity \( g \), is a small vertical plane of paper, covered with turpentine, which serves as a counterpoise to the ball \( a \).
ELECTRICITY.

Into the hole $m$, is introduced a small cylinder $m x t$, the lower part of which, $x t$, is formed of gum lac, and carries a pith ball $t$. At six inches from the bottom of the glass cylinder there is pasted round its circumference a band of paper $z q$, divided into 360 degrees, so as to be on a level with the needle $a g$.

In order to adjust this instrument for use, the hole $m$ is made to correspond to the zero of the scale $z q$. The index $o f$ of the micrometer is then placed upon the zero of its graduated circle $o p$, and the whole micrometer is turned in the tube $f h$, till, in looking past the vertical silver wire $P$, and the centre of the ball, the needle $a g$ shall correspond with the zero of the scale $z q$.

The other ball $t$ is then introduced, so that it may touch the ball $a$, and so that a line joining the centre of the silver wire, and the ball $t$, may also point to the zero of the scale $z q$.

**Coulomb's Method of determining the Law of the Repulsive Force.**

When the instrument was thus adjusted, Coulomb applied it in the following manner to determine the law of the repulsions of the two balls $t$, $a$. Having provided a brass pin $A B$, Fig. 11, with a large head, he stuck it into a handle AC of sealing-wax, and having electrified it he introduced it through the hole $m$, Fig 7, and touched the ball $t$ in contact with $a$. The electricity of the pin was thus communicated to the two balls, which of course possessed the same kind of electricity; and as soon as the pin was withdrawn, the balls mutually repelled each other to a distance which is measured by observing the degree on the circle $z o q$, which is pointed out by a line joining the silver wire and the ball $a$. If then the index $o$ of the micrometer is now turned in the direction $p o n$, the silver wire $P$ will be twisted, and we shall produce a force proportional to the angle of torsion, which is requisite to make the ball $a$ return to the ball $t$. By this means he observed the distance at which different angles of torsion bring back the ball $a$ to the ball $t$, and in comparing the forces of torsion with the corresponding distances of the balls, he obtained a measure of their repulsive force.

**Exp. 1.** The two balls being electrified with the head of the pin, and the index of the micrometer being set to zero, the ball $a$ was repelled by the ball $t$ to the distance of 36 degrees.

**Exp. 2.** The silver wire being twisted by turning the index of the micrometer 126 degrees, the ball $a$ approached to $t$, and stopped at the distance of 18 degrees from it, having moved backwards through an arc of 18°.

**Exp. 3.** Having again twisted the silver wire through an arc of 567°, the two balls approached, and stopped at the distance of 8½.

Now, as the force of torsion, or the force which is capable of keeping a thread twisted to a certain degree, so as to hinder it from turning round its axis, and recovering its natural state, has been shewn by Coulomb to be proportional to the angle of torsion, or the arch through which it has been twisted, we have in these experiments a force of torsion equal to 567°; and in the second experiment, when the distance of the balls was 18°, the angle, and consequently the force of torsion, was $126° + 18° = 144°$; so that the repulsive force, at the distance of 36°, was 36°; and the repulsive force, at the distance of 18°, was 144°, or quadruple at half the distance. In the third experiment, when the distance of the balls was 8½°, the force of torsion was 567°; so that, at a quarter of the distance, the repulsive force was nearly eight times as great. Hence it follows, that the repulsive force of two small globes electrified either positively or negatively, is in the inverse ratio of the squares of the distance of the centres of the two globes.

In the preceding experiments, the wire $P$ was 28 inches long, and $\frac{1}{4}$th of a grain in weight, and the force necessary to twist it through an angle of 360°, when at the distance $a P$, or four inches from the wire, is $\frac{1}{4}$th of a grain, as calculated from the formula given by Coulomb in his Memoir on the force of Torsion. Hence the real forces in the preceding experiments were,

**Distances of the Balls.** | **Angles and Forces of Torsion.** | **Absolute Forces in grains.**
---|---|---
36° | 36 | $\frac{1}{4}$th of a grain.
18 | 144 | $\frac{1}{4}$th
5½ | 567 | $\frac{1}{4}$th

M. Coulomb has remarked, that with a silver wire, so fine as that which he used, and which requires only a force of $\frac{1}{4}$th part of a grain to twist it through an angle of 90°, it is impossible, with every precaution, to ascertain the position of the needle to within 2° or 3° when the force of torsion is nothing. He recommends therefore, after electrifying the balls, to twist the wire 30° or 40°, which, joined to the observed distance of the two balls, will give a force of torsion so great as to remove any sensible error arising from the uncertainty of 2° or 3° already mentioned. He recommends also the use of a wire nearly double in diameter to that which he used, as it was liable to break with the least agitation. A wire of this thickness should also be stretched for two or three days by a weight equal to half of that which is necessary to break it, and should never be twisted through an arch of more than 300°.

It must have already occurred to the reader, that while these experiments are making, the balls were losing their electricity. Coulomb found, that when they repelled one another through an arch of 30°, they reapproached one another about one degree in three minutes; but as he was able to make the experiments in two minutes, he did not consider it necessary to make any correction for the loss of electricity. By observing, however, the rate at which the electric matter is dissipated during every minute, a correction may be applied when the air is very moist, or when the dissipation happens to be considerable.

In the preceding experiments, the distance of the balls was measured by the angular distance to which they were separated, which is greater than the chord, or the correct distance; but this is in a great degree compensated by an opposite error, arising from making the lever, by which the force acts, equal to the radius, or half the length of the needle, whereas it is equal only to the cosine of half the angular distance of the balls. This compensation is sufficiently corrected when the distance of the balls does not exceed 25 or 30 degrees; but, at greater angles, the distance between the balls and the length of the lever must be accurately computed.

**Coulomb's Methods of determining the Law of the Attractive Force.**

The next object of M. Coulomb was to determine the law which regulated the action of two oppositely electrified bodies; but in employing his apparatus for this purpose, he encountered a practical difficulty which he
ELECTRICITY.

Distance of the centre of \( i \) from the centre of \( G \) | Number of oscillations performed by the needle \( lg \) | Number of seconds in which these oscillations were performed
---|---|---
9 | 15 | 20°
18 | 15 | 40°
24 | 15 | 60°

From these experiments we may now deduce the attractive force of the globe \( G \) at the distances 9, 18, and 24; for the oscillations of the needle (abstracting the effect of the force of torsion) are produced solely by the action of that globe, in the same manner as the oscillations of a pendulum are produced by the action of gravity. As the circle \( d \) is only 7 lines in diameter, we may safely suppose all the lines drawn from the centre of \( G \) to every part of the plate as equal and parallel, and the whole of its action united in its centre \( l \). If we now call \( F \) the attractive force, and \( T \) the time in which a given number of oscillations are performed, we shall have \( T \) proportional to \( \frac{1}{\sqrt{F}} \); but if we make \( d = Gl \), the distance of the centres of the circle and globe, and suppose the attractive force to be inversely as the squares of the distances, or as \( \frac{1}{d^2} \), then it will follow that \( T \) is proportional to the distances \( d \); so that if this law is correct, the time of any number of oscillations should be as the corresponding distances between the centres of the globe and the circle. Now,

The distances are as the numbers \( 3\ 6\ 8 \),
The times in which 15 oscillations are performed by experiment \( 20\ 41\ 60 \),
The times in which they are performed by theory \( 20\ 40\ 54 \).

The difference between the theory and the experiment is almost 0 at the distance of 18 inches, but at the distance of 24 it is nearly \( \frac{1}{\sqrt{2}} \). A correction, however, remains to be applied to the experimental result; for as four minutes were spent in the experiments, the globe and the plate had lost a portion of their electricity. Coulomb found that the action was diminished \( \frac{1}{\sqrt{r}} \) of the whole per minute, and therefore \( \frac{1}{\sqrt{r}} \) in 4 minutes. Consequently, in order to obtain the correct number instead of 60°, we have \( \frac{1}{\sqrt{10}} : \frac{1}{\sqrt{9}} = 60° \) : 57°, which differs only \( \frac{1}{\sqrt{10}} \) from the number 60° determined experimentally. Hence it follows, that the law of the inverse ratio of the squares of the distances is correct also, for the attractive forces of oppositely electrified bodies.

We have already stated, and the reader must himself have made the remark, that the oscillations of the needle \( lg \) are partly due to the force of torsion, and are not produced solely by the mutual attraction of the globe and the gilt circle. Coulomb, however, has shewn, that the force necessary to twist through a whole arch of 360° a silken fibre 6 inches long, and acting at the
on the Disseption of Electricity.

When any electrified body is insulated in the most perfect manner, the quantity of electricity which it possesses is found to suffer a gradual, and sometimes a rapid diminution, till the whole of its electricity is completely dissipated. It becomes a matter of the greatest importance, therefore, to determine the law according to which this dissipation takes place, and we are fortunately able to lay before our readers a series of beautiful experiments which have been made by Coulomb, by means of the very delicate apparatus which we have already described.

When any insulated electrified body dissipates its electricity, the effect is produced by three causes; 1. By the conducting power of the air which surrounds the electrified body; 2. By the deposition of humidity on the surfaces of the electrics, which are employed to insulate the electric body; and, 3. By the imperfect insulation produced by the best non-conductors. The last of these causes has probably the smallest share in the dissipation of the electric fluid, and cannot easily be estimated separately from the rest.

In measuring the dissipation produced by the two first causes, the reader must see, that there is some difficulty in separating the effects of the one cause from those of the other; for as the electrified body must always be insulated by imperfect conductors, the real quantity of electricity dissipated during a given time must be owing to both causes. Coulomb, whose inductive genius overcame every difficulty, has succeeded completely in separating the two effects. He saw, that if the portion of the surface of the electrified body, which communicated with the insulating support, was made extremely small, the loss of electricity along this support must be immeasurably minute, in comparison with the loss which was due to the humidity of the ambient air. He therefore put this idea to the test of experiment, and found, that when the electrified body did not possess much electricity, such as a pith ball 5 or 6 lines in diameter, he could insulate it completely by a cylinder of sealing-wax, or gun lac, about half a line in diameter, and 18 or 20 lines long; that a very fine silk thread, penetrated with melted wax, and covered with wax, so as to form a cylinder of a line in diameter, had the same insulating power when it was 5 or 6 inches long; and that an equal degree of insulation could not be procured by a fine thread of glass 5 or 6 inches long, or by a hair, or by a fibre of silk, unless when the air was uncommonly dry, or the electric density of the ball was weak.

1. On the Disseption of Electricity by the Contact of Air.

Having suspended a pith ball similar to that upon the needle ag, to a very fine silk fibre, covered with sealing-wax, and terminated with a cylinder of gun lac 18 or 20 lines in diameter, Coulomb introduced it through the opening m in his torsion balance, so as to touch the pith ball a, as in the former experiments. By means of the conductor, Fig. 11, he communicated the same kind of electricity to the two balls, which immediately repelled one another to such a distance, that the repulsive force was equal to the force of torsion. Let us suppose that the angular distance of the balls was 40°, then twisting the thread of suspension through 140°, Coulomb brought the ball back to 20°. He next observed the instant when this ball pointed exactly to 20°. As the electricity was dissipated, the balls approached one another some minutes after the operation; so that, after the distance of 20°, he twisted the thread of suspension 30° by means of the index, and as the force of torsion was diminished by these 30°, the balls repelled a little more than 20°. He then waited the instant when the ball of the needle arrived at 20°, and counted, with great exactness, the time which elapsed between the two operations. Suppose that this time was three minutes, then it will follow, that at the first observation the distance of the balls was 20°, and the repulsive force 140° - 20° = 160°; that three minutes after, the repulsive force at the same distance of 20°, was only 110° - 20° = 130°, or was diminished 30°, or 10° per minute. Hence as the mean force between the two observations was 160° - 130° = 145°, and diminished 10° per minute, it follows that the electric force of the two balls diminished 10° per minute.

In this way Coulomb constructed the following Table, which contains the observations made on the 28th May, the 29th May, the 22d June, and the 2d July, which he selected from a multitude of others, as on these four days the variation of the humidity of the air was very great, while its temperature was very nearly the same.

In this Table, the first column represents the instant of observation; the second, the distance of the balls; the third, the degree of torsion given by the micrometer; the fourth, the time which elapsed between two consecutive observations; the fifth, the loss of the electric force during that time; the sixth, the mean force of repulsion between the two observations, as measured by the mean torsion indicated by the micrometer added to the distance of the two balls; and the seventh, the ratio of the electric force lost in one minute to the total force.
**TABLE for determining the Quantity of Electricity lost in a Minute by the contact of Air.**

**FIRST SET OF EXPERIMENTS. May 28, Morning.**

Barometer 28.3 Inches.
Thermometer 15° Degrees of Reaumur.
Hygrometer 75 Saussure's Hygrometer.

<table>
<thead>
<tr>
<th>Time when the Observations were made</th>
<th>Distance of the electrified Balls</th>
<th>Degrees of Torsion shown by the Micrometer</th>
<th>Interval between two consecutive Observations</th>
<th>Electric Force lost between the two Observations</th>
<th>Mean Force of Repulsion between two Observations</th>
<th>Ratio of the electric Force lost per Minute, to the total mean electrical Force of the Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exp. 6°32' 30''</td>
<td>30</td>
<td>120°</td>
<td>5°</td>
<td>20</td>
<td>140</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>2. Exp. 6° 38 15</td>
<td>30</td>
<td>100°</td>
<td>6°</td>
<td>20</td>
<td>120</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>3. Exp. 6° 44 30</td>
<td>30</td>
<td>80°</td>
<td>8°</td>
<td>20</td>
<td>100</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>4. Exp. 6° 53 0</td>
<td>30</td>
<td>60°</td>
<td>10</td>
<td>20</td>
<td>80</td>
<td>(\frac{3}{10})</td>
</tr>
<tr>
<td>5. Exp. 7° 3 0</td>
<td>30</td>
<td>40°</td>
<td>14</td>
<td>20</td>
<td>60</td>
<td>(\frac{3}{10})</td>
</tr>
<tr>
<td>6. Exp. 7° 17 0</td>
<td>30</td>
<td>20°</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECOND SET OF EXPERIMENTS. May 29.**

Barometer 28.4 Inches.
Thermometer 15° Degrees of Reaumur.
Hygrometer 69 Saussure's Hygrometer.

<table>
<thead>
<tr>
<th>Time when the Observations were made</th>
<th>Distance of the electrified Balls</th>
<th>Degrees of Torsion shown by the Micrometer</th>
<th>Interval between two consecutive Observations</th>
<th>Electric Force lost between the two Observations</th>
<th>Mean Force of Repulsion between two Observations</th>
<th>Ratio of the electric Force lost per Minute, to the total mean electrical Force of the Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exp. 3° 45' 30''</td>
<td>30</td>
<td>130°</td>
<td>7°</td>
<td>20</td>
<td>150</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>2. Exp. 5° 53 0</td>
<td>30</td>
<td>110°</td>
<td>9°</td>
<td>20</td>
<td>130</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>3. Exp. 6° 2 30</td>
<td>30</td>
<td>90°</td>
<td>9°</td>
<td>20</td>
<td>110</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>4. Exp. 6° 12 15</td>
<td>30</td>
<td>70°</td>
<td>20</td>
<td>30</td>
<td>75</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>5. Exp. 6° 33 30</td>
<td>30</td>
<td>40°</td>
<td>18</td>
<td>20</td>
<td>60</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>6. Exp. 6° 51 0</td>
<td>30</td>
<td>20°</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**THIRD SET OF EXPERIMENTS. June 22.**

Barometer 27.11 Inches.
Thermometer 15° Degrees of Reaumur.
Hygrometer 87 Saussure's Hygrometer.

<table>
<thead>
<tr>
<th>Time when the Observations were made</th>
<th>Distance of the electrified Balls</th>
<th>Degrees of Torsion shown by the Micrometer</th>
<th>Interval between two consecutive Observations</th>
<th>Electric Force lost between the two Observations</th>
<th>Mean Force of Repulsion between two Observations</th>
<th>Ratio of the electric Force lost per Minute, to the total mean electrical Force of the Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exp. 11° 53' 45''</td>
<td>20</td>
<td>80°</td>
<td>3</td>
<td>20</td>
<td>90</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>2. Exp. 11° 56 45</td>
<td>20</td>
<td>60°</td>
<td>3</td>
<td>20</td>
<td>70</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>3. Exp. 11° 59 45</td>
<td>20</td>
<td>40°</td>
<td>3</td>
<td>20</td>
<td>50</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>4. Exp. 12° 5 0</td>
<td>20</td>
<td>20°</td>
<td>5°</td>
<td>20</td>
<td>50</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>5. Exp. 12° 16 15</td>
<td>20</td>
<td>5°</td>
<td>11°</td>
<td>25</td>
<td>28</td>
<td>(\frac{7}{10})</td>
</tr>
</tbody>
</table>

**FOURTH SET OF EXPERIMENTS. July 2.**

Barometer 28.2 Inches.
Thermometer 15° Degrees of Reaumur.
Hygrometer 80 Saussure's Hygrometer.

<table>
<thead>
<tr>
<th>Time when the Observations were made</th>
<th>Distance of the electrified Balls</th>
<th>Degrees of Torsion shown by the Micrometer</th>
<th>Interval between two consecutive Observations</th>
<th>Electric Force lost between the two Observations</th>
<th>Mean Force of Repulsion between two Observations</th>
<th>Ratio of the electric Force lost per Minute, to the total mean electrical Force of the Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exp. 7° 43' 40''</td>
<td>20</td>
<td>80°</td>
<td>5°</td>
<td>20</td>
<td>90</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>2. Exp. 7° 49 0</td>
<td>20</td>
<td>60°</td>
<td>8°</td>
<td>20</td>
<td>70</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>3. Exp. 7° 57 20</td>
<td>20</td>
<td>40°</td>
<td>12</td>
<td>20</td>
<td>50</td>
<td>(\frac{7}{10})</td>
</tr>
<tr>
<td>4. Exp. 8° 9 15</td>
<td>20</td>
<td>20°</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Exp. 8° 17 30</td>
<td>20</td>
<td>10°</td>
<td>8°</td>
<td>10</td>
<td>35</td>
<td>(\frac{7}{10})</td>
</tr>
</tbody>
</table>
It will appear by examining the seventh column, that the ratio of the electric force lost to the total force is a constant quantity during the same day, or while the air has the same degree of humidity; from which it follows, that the loss of electricity is always proportional in the same state of the air to the electrical density.

From these experiments, Coulomb has shown how to determine the electricity of the two balls after any given time. Thus from the first set of experiments in the Table, when the dissipation is $\frac{1}{4}$, every minute, he has shown, that if we make $t$ the interval of time, $d$ the electrical density of each ball, and $D$ the primitive density of the electric fluid in each ball, and $\mu$ the modulus of the logarithmic system, then we shall have

$$t = \log \left( \frac{D}{d} \right)$$

but as the distance is constant, $D$ is proportional to the primitive action, and $d$ to the action while the time is $\frac{1}{4}$. Hence in using the ordinary table, where the modulus $\mu = 0.4343$, we shall have

$$0.4343 t = \log \left( \frac{D}{d} \right)$$

If we now seek from this formula the value of $d$ in the 1st experiment, it will be found that at the first experiment $D = 150$, and that at the 6th experiment $d = 50$. Hence

$$0.4343 \log 3 = 0.4343 = 3$$

and consequently $t = \log 3 = 0.4343$ by the experiment.

Now the first experiment commenced at 6 h 32' 30" and the sixth at 6 h 17', the difference of which is 44' 30'' instead of 45', as found by the experiment.

Coulomb has also shown, that the ratio of the force lost in a minute to the total force, is double of the ratio of the loss of the density of each body to the total density. For calling $d$ their electrical density, and $a$ their distance, then since the two balls are equal, and receive at first the same quantity of electricity, their reciprocal action will be represented by $\frac{d}{a^2}$, and consequently its momentary diminution will be proportional to $\frac{2dd}{a^2} + \frac{dd}{a^2}$. Hence the ratio of this variation of repulsion to repulsion itself, will be, neglecting $d_d$, equal to $\frac{2d}{d}$. But $\frac{d}{d}$ is the relation of the loss of density of each ball to its own density, and consequently the dissipation is only one-half of the diminution of repulsion. Thus in the experiment of the 28th of June, the diminution of repulsion was $\frac{1}{4}$, from which it follows that the dissipation was $\frac{1}{4}$ per minute.

Our author made a great number of experiments of a similar kind with balls of different magnitudes, and when the quantity of electricity, as well as the electrical density of each ball, were very different, he always found, that the ratio of the dissipation of the electric force during a minute, to the total force, was uniformly a constant quantity. On the 28th June, for example, though he presented to the ball $a$ a ball double the size, and though he communicated to this ball a degree of electricity greater or less than that of the ball $a$, yet the loss of the electrical force was constantly $\frac{1}{4}$ per minute.

The most important result, however, which he obtained, was, that when the air was dry, and the degree of electricity not great, the ratio of the decrease of the electrical density to the density itself, was always a constant quantity, whatever was the form, and whatever the magnitude of the electrified body. This experiment was made with a globe a foot in diameter, and with cylinders of all lengths and magnitudes; he even substituted, in the place of the balls, circles of paper and of metal; and, on a dry particularly dry, he armed one of the balls with a small copper wire 4th of a line in diameter, and 10 lines long; and in measuring the dissipation of its electricity, he found that every body which he used on that day lost the 8th part of its electricity in a minute. It must be carefully observed, however, that this equality of dissipation exists only when the electric density has been reduced to a certain point; for, when the electricity is very strong, all angular bodies dissipate their electricity according to a law which will afterwards be determined.

The nature of the body, too, has no influence on the law of the dissipation. On the 28th June, the electricity decreased $\frac{1}{4}$ per minute when pitch balls were used; and the same result was obtained when the balls were made of copper or of sealing-wax.

The next object of Coulomb was to discover the relation which subsisted between the humidity of the air and the dissipation of electricity. He therefore drew up the following Table, in which the first column marks the day when the observations were made; the second the state of Saussure's hygrometer; the third the quantity of water dissolved in a cubic foot of air, when the thermometer is between 10$^1$ and 10$^2$ of Nélaton, according to the experiments of Saussure; and the fourth, the dissipation of electricity per minute.

<table>
<thead>
<tr>
<th>Time of Observation</th>
<th>State of Saussure's Hygrometer</th>
<th>Quantity of water dissolved in a cubic foot of air</th>
<th>Electricity lost per minute.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. May 29th</td>
<td>69</td>
<td>6.197</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>2. May 28th</td>
<td>75</td>
<td>7.295</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>3. July 2d</td>
<td>80</td>
<td>8.045</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>4. June 22d</td>
<td>87</td>
<td>9.281</td>
<td>$\frac{1}{4}$</td>
</tr>
</tbody>
</table>

If we now wish to determine the law between the dissipation of the electricity and the quantity of water in the atmosphere when the thermometer is between 10$^1$ and 10$^2$, the temperature when the four experiments were made, let us call $m$ the power which expresses that relation; then comparing the experiment with the three others, we shall obtain,

Experiments compared

1st and 2d, $m = (7.197) \div (6.180)$, whence $m = 2.76$

1st and 3d, $m = (8.045) \div (6.180)$, whence $m = 2.76$

1st and 4th, $m = (9.281) \div (6.180)$, whence $m = 3.61$

Mean $m = 3.05$

Hence it follows, that the diminution of the repulsive force, or, what is the same, of the electric density,
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is proportional to the cube of the weight of the quantity of water dissolved in a given volume of air.

The preceding conclusion, however, cannot be considered as certain, since it depends upon several circumstances which have not been determined with sufficient exactness. Coulomb proposed to enclose the balls in different kinds of air, to communicate to the air different degrees of humidity, and then to determine the law of the dissipation of the electricity of the balls; but he found this investigation too arduous, for want of proper instruments for measuring the purity and the humidity of the different gases which he employed.

Although the quantity of water dissolved in a given quantity of air increases with the temperature, yet this is not indicated by the hygrometer of Saussure. As the conducting power of the air, therefore, must increase with the temperature, the dissipation of electricity ought to be greater in warm weather than in cold weather, even when Saussure's hygrometer indicates the same degree of humidity. This conclusion Coulomb confirmed by experiment; but the law of the increase depending on the augmentation of temperature, he has not been able to ascertain. Saussure* has published a Table, shewing the correspondence between the degrees of his hygrometer, and the quantity of water which a cubic foot of air holds in solution at every degree of the thermometer. But this Table is not given by its author as correct; and therefore Coulomb merely concludes, in general, that, in proportion as the temperature increases, the dissipation of electricity is not so great as it ought to be, by calculating from Saussure's Table.

The dissipation of electricity seems also to be affected by some other causes, which it is not easy to discover. On different days, when the barometer, the thermometer, and the hygrometer, indicated that the air was in the same state, the dissipation underwent considerable changes. The only general observation which Coulomb was enabled to make, was, that when there was a sudden change of weather, and when the hygrometer varied sensibly in a few hours from moist to dry, the loss of electricity, relative to its density, remained, during some time, greater than it ought to be, according to the degree of dryness indicated by the hygrometer, and vice versa when the hygrometer changes suddenly from dry to moist. If, in 12 or 15 hours, for example, the hygrometer passes from moist to dry eight or ten degrees, and that it afterwards remains stationary at that degree of dryness for several days, it will often happen that the electrical density will decrease the first day after this rise of the hygrometer, at the rate of \( \frac{1}{7} \) per minute. Some days afterwards, though the hygrometer is stationary, the electricity density will decrease more than \( \frac{1}{7} \) per minute. Coulomb ascribes this variation to the aqueous vapours contracting an adhesion to the air, after having conti-
### TABLE for determining the loss of Electricity along imperfectly Insulating Electrics.

#### FIRST SET OF EXPERIMENTS.

**May 28th.**

<table>
<thead>
<tr>
<th>Time when the Observations were made</th>
<th>Distance of the Electrified Balls</th>
<th>Degrees of Torsion shown by the Micrometer</th>
<th>Interval between two consecutive Observations</th>
<th>Electric Force lost between the two Observations</th>
<th>Mean Force of Repulsion between the two Observations</th>
<th>Ratio of the Electric force lost per Min. to that which remains in the Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exp. 10h 0' 0&quot;</td>
<td>30</td>
<td>150}</td>
<td>2' 40'</td>
<td>20</td>
<td>170</td>
<td>25</td>
</tr>
<tr>
<td>2. Exp. 10 2 20</td>
<td>30</td>
<td>120}</td>
<td>5</td>
<td>40</td>
<td>130</td>
<td>25</td>
</tr>
<tr>
<td>3. Exp. 10 9 0</td>
<td>30</td>
<td>80}</td>
<td>5</td>
<td>20</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>4. Exp. 10 13 0</td>
<td>30</td>
<td>60}</td>
<td>16}</td>
<td>40</td>
<td>70</td>
<td>25</td>
</tr>
<tr>
<td>5. Exp. 10 29 20</td>
<td>30</td>
<td>20}</td>
<td>21</td>
<td>20</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>6. Exp. 10 50 20</td>
<td>30</td>
<td>0}</td>
<td>16}</td>
<td>10</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>7. Exp. 11 7 0</td>
<td>30</td>
<td>10}</td>
<td>10</td>
<td>10</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

#### SECOND SET OF EXPERIMENTS.

**May 29th.**

<table>
<thead>
<tr>
<th>Time when the Observations were made</th>
<th>Distance of the Electrified Balls</th>
<th>Degrees of Torsion shown by the Micrometer</th>
<th>Interval between two consecutive Observations</th>
<th>Electric Force lost between the two Observations</th>
<th>Mean Force of Repulsion between the two Observations</th>
<th>Ratio of the Electric force lost per Min. to that which remains in the Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exp. 7h 34' 0&quot;</td>
<td>30</td>
<td>150}</td>
<td>2' 40'</td>
<td>20</td>
<td>170</td>
<td>25</td>
</tr>
<tr>
<td>2. Exp. 7 3 40</td>
<td>30</td>
<td>130}</td>
<td>5</td>
<td>40</td>
<td>150</td>
<td>25</td>
</tr>
<tr>
<td>3. Exp. 7 41 30</td>
<td>30</td>
<td>110}</td>
<td>6</td>
<td>20</td>
<td>130</td>
<td>25</td>
</tr>
<tr>
<td>4. Exp. 7 48 20</td>
<td>30</td>
<td>90}</td>
<td>7</td>
<td>20</td>
<td>110</td>
<td>25</td>
</tr>
<tr>
<td>5. Exp. 7 55 45</td>
<td>30</td>
<td>70}</td>
<td>11</td>
<td>20</td>
<td>70</td>
<td>25</td>
</tr>
<tr>
<td>6. Exp. 7 8 30</td>
<td>30</td>
<td>50}</td>
<td>17</td>
<td>20</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>7. Exp. 8 25 0</td>
<td>30</td>
<td>30}</td>
<td>17</td>
<td>15</td>
<td>38</td>
<td>25</td>
</tr>
<tr>
<td>8. Exp. 8 42 30</td>
<td>30</td>
<td>15}</td>
<td>22</td>
<td>14</td>
<td>38</td>
<td>25</td>
</tr>
<tr>
<td>9. Exp. 9 5 0</td>
<td>30</td>
<td>1}</td>
<td>22</td>
<td>14</td>
<td>38</td>
<td>25</td>
</tr>
</tbody>
</table>

Conclusions deduced from the preceding Table.

It appears from the preceding Table, that the diminution of electricity is at first much more rapid when the electrical density is considerable, than it ought to be if it were produced solely by the contact of the air; and when this density is reduced to a certain degree, the diminution of electricity becomes precisely the same as it is when the insulation is perfect, or as it is when the dissipation is entirely due to the contact of the air.

It follows, therefore, from this observation, that the silken fibre 15 inches long is a perfect insulator when the reciprocal action of the two balls is measured in the first set of experiments in the preceding Table by a force of torsion of 40° or under, since the loss of electricity is then only 2½ per minute, the very same dissipation that took place on the same day, and that was due solely to the contact of the air.

It results likewise, that in the second set of experiments in the above Table, the silk fibre 15 inches long insulated perfectly when the repulsive action of the two balls was 70° or under, for then the dissipation was 2½, or, the very same that was obtained on the same day, and that was due solely to the conducting power of the air.

Since the repulsive forces are measured at a constant distance, by the product of the densities of the two equal balls, the next object of Coulomb was to ascertain the relation between the primitive density, and the different degrees of density of the ball supported by the silken fibre, when the silk fibre begins to insulate the ball in a perfect manner.

In the first set of experiments in the preceding Table, the two balls were equally electrified. The ball a upon the needle insulated by means of gum lac lost 2 × 71° = 40° of its electricity per minute, solely by the conducting power of the ambient air. The other ball supported by the silken fibre, dissipated its electricity not only by the contact of the air, but also by its imperfectly-insulating support; and it was not till 10° 40' that the silk fibre began to insulate completely the second ball, at which time the repulsive force of the two balls was 40°. But at 10°, the beginning of the experiment, the repulsive force of the two balls equally electrified was 180°. Since the action at a constant distance is always proportional to the product of the densities, and since the densities at the first experiment were equal, the electric density of each ball is proportional to √180 at 10° 0'. But we have already seen, (p. 446. col. 1.) that the dissipation of electricity from the contact of air was \( \frac{d}{2} = mi \), where \( d \) is the density at the end of any time \( t \), and \( m = 2 \times 71° = 40° \) in col. 7. of the first set of experiments in the preceding Table.

Now the fluent of the above formula is \( \frac{D}{d} = \frac{0.4343}{82} \), \( D \) being the primitive density of the ball, and 0.4343
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4. The modulus of the common logarithms. Hence we shall have

\[ \log d = \log D - \frac{0.4343}{82}. \]

Now if we wish to know the density \( D \) after 40 minutes, when the silk fibre begins to insulate perfectly, we shall find for the ball \( a \) supported by gum lac, and perfectly insulated during the whole of the experiment, \( D \) being equal to

\[ \sqrt{180 = 13.416}. \]

\[ \log d = 1.0176 - 0.2848. \]

Hence the electrical density of the ball of the needle at \( 10^\circ 40' \), which at \( 10^\circ 00' \) was equal to \( \sqrt{180 = 13.416} \), is now equal to 7.291. But as the action of two balls is always proportional to the product of the density, if we call \( \Delta \) the density of the ball supported by the silk fibre when it insulates perfectly, or when the action of the two balls is measured by \( 40' \), then 7.291 \( \Delta = 40' \), and \( \Delta = \frac{7.291}{40} = 52.9 \). Hence it follows, that the electrical density of the ball supported by the silk fibre is 52.9, when the fibre begins to insulate perfectly, the distance of the two balls being 30'.

Making use of the preceding formula, Coulomb found, from a comparison of several experiments, that a small cylinder of gum lac 18 lines long, did not cease to insulate perfectly till the ball was charged with a degree of electricity nearly triple that of the silk fibre, that is, assuming 52.9 for the electrical density of the ball when supported by the silk fibre 15 inches long, when it begins to insulate perfectly, we must triple this density to have the density at which the gum lac cylinder 18 lines long commences its perfect insulation.

Our author next endeavoured to find the relation between the electrical density and the length of the supports at which they begin to insulate perfectly; and he found from experiment, that the electric density, when a silk thread, or hair, or any fine cylindrical electrical commenced its perfect insulation, was proportional to the square root of the length of the support; that is, if a silk fibre, whose density is \( D \), and whose length is one foot, begins to insulate perfectly, a fibre 4 feet long will be necessary to insulate perfectly when the density is double or \( 2D \). This experimental result Coulomb has shown to be quite conformable to theory, but we cannot venture to follow this ingenious author into the field of speculation. We shall merely lay before the reader the principle upon which he proceeds.

He supposes that the imperfect insulating power of electric depends on the distance of the conducting molecules which compose the imperfectly insulating support, or which are spread over its surface, and therefore, in order that the electric matter may pass from one conducting molecule to another, it must traverse a small non-conducting space of a greater or less magnitude, according to the nature of the body. He supposes likewise, that this non-conducting space opposes a resistance constant for the same body, because the conducting molecules are uniformly distributed, or at the same distance from one another. These suppositions being admitted, Coulomb demonstrates the two following propositions. 1. That in a very delicate conducting fibre, the electric fluid is uniformly distributed throughout all its length. And, 2. That if the fibre has a certain degree of non-conducting power, the action which each point experiences will depend solely on the electrical density of the molecule in contact with this point, and that the action of the rest of the fibre may be regarded as nothing.

SECT. XI. On the Distribution of Electricity.

When any conductor receives electricity from an excited elec
tric, this electricity is instantly distributed over the body; for every part of the conductor exhibits electrical properties. It is therefore a most interesting enquiry to discover the cause by which this distribution is effected, to determine in what parts of the conductor the electricity resides, and in what manner the distribution takes place, between two or more bodies in contact, and in bodies of various forms.

The apparatus employed by Coulomb to determine these important points, is nearly the same as what we have already described. The only change which he made upon it, was to remove the divided band of paper \( z \), and to substitute in its place a wooden circle, like the horizon of a globe, resting on four pillars, and having a diameter nearly double that of the cylinder. This circle is placed in such a manner, that its centre may coincide with the axis of the wire or fibre which suspends the needle, and that the first division on the wooden circle may be in the same line with the fibre of suspension, and the centre of the ball \( a \) when the needle \( g \) is at rest.

1. On the Cause of the Distribution of Electricity.

In order to determine whether electricity was distributed over conductors by an affinity or electric attraction for one body in preference to another, or merely in virtue of a repulsive force, Coulomb instituted the following experiments.

**Exp. 1.** Having suspended in the hole \( m \) of the balance, by means of a cylinder of gum lac, a small ball of copper, so as to touch the ball \( a \) of the needle as before, he placed the centre of this ball in a straight line with the suspending fibre and the zero of the scale on the wooden circle. The ball \( a \) of the needle which touched the copper ball was then distant from the position where the torsion was nothing by the sum of the semidiameters of the two touching balls. The two balls were then electrified by the insulated pin \( CAB \), as in the former experiments, and the ball \( a \) was repelled to the 48th degree upon the scale. The suspending fibre was then twisted 120° by the head of the micrometer, in order to bring back the ball of the needle into contact with the copper ball as before, and as soon as the oscillations of the needle ceased, it stopped at 28°. At this instant Coulomb quickly brought another pith ball of the same size as the copper ball, and insulated with gum lac, into contact with the copper ball, and upon removing the pith ball, the ball \( a \) approached the ball of copper. In order to bring it back to its first distance of 28°, it was necessary to untwist the fibre, so that the micrometer marked 120° before contact, and only 44° after it.

**Exp. 2.** In place of the ball of copper, Coulomb now substituted a circle of iron, 10 lines in diameter, suspended by a cylinder of gum lac, and having its vertical plane passing through the zero on the wooden scale. He then electrified the ball \( a \) and the iron disc, as in the preceding experiment, and the ball \( a \) was repelled. In order to bring back the ball \( a \) into contact...
with the iron disc, it was necessary to twist the fibre 110°, and the ball a was now stopped at 30° from the iron disc. He then instantly touched the iron disc with a small circle of paper of the same diameter, and having withdrawn it, he found that, in order to make the ball a stop at 30°, it was necessary to untwist the fibre, or reduce the torsion to 40°.

Now, in the first of these experiments, the copper ball having, before its contact with the pith ball, repelled the ball a to 28°, while the micrometer marked 120°, the force of torsion was then 120° + 28° = 148°. But after its contact with the pith ball, it repelled the ball a only to 28°, while the micrometer indicated only 46°, so that the total force of torsion, equal to the repulsive force of the two balls, was only 46° + 28° = 72°. A minute, however, had elapsed between the two observations, and as the dissipation was then 4° a minute, the total force of torsion must be corrected by +4° of 72° or 48° nearly, so that the corrected force of torsion will be 73°, which differs only 4° from 76°, the half of 148° the former total force of torsion which measured the electric repulsion before the electricity of the copper ball was communicated to the ball of elder. Since the distance of the balls, therefore, was in both cases the same, and since the action is directly as the densities of the fluid, and inversely as the square of the distance, it follows, that the pith ball has received exactly one half of the electricity of the ball of copper, and that the ball of copper has no more affinity or elective attraction for the electric matter than the pith ball.

In the second experiment, the electricity was distributed equally between the iron disc and the disc of paper, and by trying various other substances, and repeating the experiments by means of a large torsion balance with globes of five or six inches in diameter, Coulomb always obtained the same result.

In repeating the preceding experiments, we must take care, to avoid the pith of the copper balls to remain a short time in contact, for when one of the substances is an imperfect conductor, several seconds elapse before it is able to deprive the other of half of its electricity. The time in which this distribution takes place, depends not only on the conducting power of the two bodies, but on their relative extent, and on the manner in which the contact is effected. In bringing into contact two circular discs, as in the second experiment, we must take care, that they touch one another symmetrically, or that the surface of the one is in the same plane as the surface of the other. When this precaution is not taken, the electric matter will be distributed unequally between the two discs.

On the superficial distribution of electricity.

We have hitherto seen, that in the communication and distribution of the electric matter, every part of the surface of an electrified body is charged with electricity; we have now to inquire whether this electricity pervades the whole mass of the body, or is merely distributed over its surface. The determination of this point is owing likewise to Coulomb. As a more delicate instrument was necessary for these experiments, he made the following change in his apparatus: Having formed a fibre of gum lac, about 10 or 12 lines long, and nearly as thick as a strong hair, one of its extremities was attached to the top of a small pin without a head, suspended to a silk fibre, such as comes from the silk worm; the other extremity of the gum lac fibre being fixed to a small circle of tinsel about two lines in diameter. When this electrometer is suspended in a cylinder of glass, its sensibility is so great that a force equal to a sixty thousandth part of a grain is sufficient to repel the ball and the needle to a distance of more than 90 degrees. Having communicated a small degree of electricity to the circle of tinsel, Coulomb suspended it in a glass cylinder, so as not to be affected by currents of air. He then took a solid cylinder of wood, four inches in diameter, and pierced with several holes, four lines broad and four lines deep, and having placed this cylinder upon an insulating stand, he gave it several electric sparks, either by means of a Leyden jar, or the metallic plate of an electrophorus. He next insulated, at the extremity of a small cylinder of gum lac a line in diameter, a circle of gilt paper a line and a half in diameter, and with this apparatus he made the following experiments:

Exp. 1. The tinsel of the electrometer being electrified, as we have already stated, he touched the surface of the electrified wooden cylinder by the circle of gilt paper, and upon presenting it to the electrometer, the tinsel was repelled with force.

Exp. 2. He then introduced the circle of gilt paper into one of the holes of the cylinder, so as to make it touch the bottom of the hole, and upon presenting it to the electrometer no signs of electricity were exhibited.

Exp. 3. When it was made to touch it, and consequently received a quantity of electricity equal to that which was contained in a part of the surface equal to that of the small circle. The small circle was not only charged with a quantity of electricity perceptible to the small electrometer, but capable of being exactly measured by it.

In the second experiment, on the contrary, when the small circle was placed at the bottom of one of the holes, four lines below the surface, and twenty lines from the axis of the cylinder, and when it was taken out of the hole, so as not to touch its sides, it exhibited no marks of electricity; and hence it follows that there was no electric matter in the interior of the cylinder, even at the small depth of four lines. On some occasions, the circle of gilt paper exhibited signs of a weak electricity, opposite to that of the cylinder, an effect which Coulomb ascribes to a small degree of electricity received by the gum lac, from its being within the atmosphere of the electrified cylinder. In order to prove that this opposite electricity existed in the gum lac, and not in the circle of gilt paper, he touched the gilt circle, and was not able to destroy its electricity. The opposite electricity of the gilt circle is, however, always very feeble when the gum lac is pure, and when the weather is not very damp.

On the distribution of electricity between two conducting bodies in contact.

In the experiments of Coulomb on this subject, he found it necessary to employ a torsion balance of a larger size than that which is represented in Plate CCXLV. and of a different form. The two balances which he used, are represented in Plate CCXLV. Fig. 1 and 2. In Fig. 1, AB is a square box, formed by four plates of glass, 2 feet long and 15 or 16 inches high, which must be placed upon a table, very dry, and coated with a non-conducting varnish. This square box is covered
with glass, so as to leave an opening for introducing the globe $a$, placed at the end of a small cylinder $ac$ of gum lac, which is terminated upwards in a small cylinder of baked wood, coated with gum lac, and passing perpendicularly through a hole in the piece of wood $cd$, in which it is stopped by a screw $e$. The vertical tube $mn$ from 12 to 15 inches high, is made of glass, and is supported by a frame $pqrs$, carrying a semicircle $t, 0, w$, about four feet in diameter, having its centre coincident with the vertical line $mn$, and divided into two quadrants of 90° each, beginning at 0. The suspending fibre $mn$ carries the piece $uv, w$, to which is attached a thread of gum lac $ub$, terminated in $b$ by a small disk of gilt paper.

Fig. 2. Represents another balance of the same kind, but still more simple. The four vertical and square plates of glass, rise from a groove in a piece of well baked wood. Instead of the semicircle $t, 0, w$, a band of paper $mn$ is pasted on one of the glass plates, and on both sides from 0 is divided into degrees, according to the tangents of a circle, whose centre is the suspending fibre.

The micrometer $m$, at the top of both these balances, does not differ materially from that which has been represented in a former Figure. The head of it consists of two circles, the lowest of which has a space of five degrees divided into single degrees, while the other circle is divided into spaces of five degrees each. These two circles are intended to adjust the needle to the zero of the scale. The suspending fibre in both these balances was a copper wire of the diameter No. 12. in commerce.

In using the preceding apparatus, Coulomb employed two methods for determining the manner in which the electric matter distributed itself between two bodies in contact. In the first, he placed the electrified body in the balance, after having electrified in the same manner the small circle of gilt paper at the end of the needle. The needle being repelled through a certain distance, was then brought back by means of the micrometer to any distance from the electrified body; and the angle of torsion given by the micrometer, added to the distance of the needle from the zero of the scale, measured the repulsive force which the bodies exercised at that distance. The electrified body placed in the balance, was then touched by the body with which it was to divide its electricity; and in unwinding the suspending fibre, the needle was brought back to the same distance from the body as formerly, and then the angle of torsion added to the distance of the needle from zero, measured the quantity of electricity which was left in the body by the other, to which part of its electricity was distributed. In this method, unless the weather is very dry, it is necessary to take into account the dissipation which happens during the interval of observation. The preceding method was employed by Coulomb, when he wished to determine the relation between the quantities of electricity in two bodies; but, in order to measure the electric density in each point of a conductor, he had recourse to the following ingenious method.

In the small balance with which he made his first experiments, he suspended his needle by a fine silver wire. He then formed a cylinder of gum lac, bent as at $ed$ in Fig. 3, and of the thickness of a hair, and to the end of it he attached a circle of gilt paper $c$. After having electrified the disc carried by the needle with an insulated pin as before, he electrified the body upon which the experiments were to be made, and then touched the circle $c$ with the point of the body, whose electrical density he wished to ascertain. He then placed this circle in the balance, and ascertained the quantity of its electricity. Now as this circle is only five or six lines in diameter, and the 18th part of a line thick, the electrical density which it acquires by the tangential contact, is either the same with that of the point which it touches, or proportional to that density. Hence by making this circle touch different points of a conductor, in succession, and by presenting it after every contact to the needle of the balance, taking care that it shall always have the same position, Coulomb was enabled to ascertain the electrical densities of different points of conductors.

In the comparison of succeeding observations, we must obviously take into account the dissipation of electricity by the contact of air, and the method by which this has been done by Coulomb is remarkably simple and ingenious. In order to compare the electrical density of two points, he first touched one of the points by the paper circle, and determined its density by placing the circle in the balance as before. He then touched the second point, and determined its density in a similar manner; and after an interval equal to that which had elapsed between the two touchings, he touched the first point anew, and again determined its density, which was of course less than before, from the effect of dissipation. He then took the mean between the two densities found for the first point, which was therefore the real density at the instant of the second observation, so that the two densities thus measured were free from any error arising from dissipation.

This method, though in general the most convenient and simple, as well as the most exact, is nevertheless affected with an error in practice, arising from the gum lac not being perfectly impenetrable to the electric matter. This error is greatest in damp weather, and with impure gum lac, the least clear being generally the most impenetrable by the electric matter. In order to get rid of this error, it is necessary always to try its non-conducting power, by touching the electrified body with the extremity $e$, and observing if it has any effect upon the needle of the balance; if any sensible change is produced upon the needle, the cylinder of gum lac must be rejected. With these precautions, Coulomb made the following experiments.

4. On the Distribution of Electricity between two Globes of different Diameters, and in Contact.

Having placed in the great balance, Fig. 1, an electrified globe six inches and three lines in circumference, he observed the force of torsion which was necessary to bring back the needle to a distance of thirty degrees from the globe. He then immediately touched the first globe with another globe 2½ inches in circumference, and observed a new force of torsion necessary to bring it back to the same distance: The following were the results which he obtained.
Descriptive Electricity.

On the distribution of electricity between two globes of different diameters, and in contact.

<table>
<thead>
<tr>
<th>Number of the Experiment</th>
<th>Distance to which the Needle was repelled by the Globe before its contact with the Second.</th>
<th>Force of Torsion necessary to bring the Needle to the preceding Distance before Contact.</th>
<th>Force of Torsion necessary to bring the Needle to the same Distance after Contact.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>145°</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>145</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>259</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>255</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
<td>231</td>
<td>19</td>
</tr>
</tbody>
</table>

Now, as the quantities of electricity before and after contact, are proportional to the angles of torsion, it is very easy to ascertain these quantities. In the first experiment the force of torsion, for a distance of 30°, was 145 before contact, and 12 after contact; so that the quantity of electricity taken by the large globe will be 145 - 12 = 133, only 12° being left to the small globe, hence the quantities of electricity possessed by the two globes are as 133 to 12, or as 11.1 to 1.0. In the same manner it will be found that this is nearly the ratio in the other four experiments. Now, the surfaces of two globes, six inches and a quarter, and 24 inches in diameter, are in the ratio of 1.48 to 1.0; hence we may conclude, that the globes are not charged with electricity in a ratio as great as that of their surfaces.

In order to find the electrical densities of the two globes, we must divide the ratio of their surfaces by the ratio of the quantities of fluid which they contain, and the quotients by the ratio of the densities. Thus, in the present case, the electrical density of the small globe will be to that of the great one as 14.3 to 11.1, or as 1.33 to 1.

In this manner Coulomb has obtained the electrical densities for globes of various sizes, and has given the general result of them in the following Table. The mean results were obtained from experiments made by both the methods which we have already described.

**TABLE showing the manner in which the Electrical Fluid distributes itself between two Globes of different Diameters.**

<table>
<thead>
<tr>
<th>Ratio of the Radii of the two Globes</th>
<th>Ratio of the Surfaces of the two Globes.</th>
<th>Ratio of Electrical Density of the two Globes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1.08</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>1.30</td>
</tr>
<tr>
<td>8</td>
<td>64</td>
<td>1.65</td>
</tr>
<tr>
<td>Infinite</td>
<td>Infinite</td>
<td>2.00</td>
</tr>
</tbody>
</table>

If any two globes, for example, have radii of 10 and 40 inches, then the ratio of these numbers are as 1 to 4, so that the ratio of their electrical densities will be as 1 to 130; it being always supposed that when they are separated the electricity is distributed uniformly over their surfaces.

5. **On the Density of the Electricity in different Points of two Globes in Contact.**

In order to determine the density of the electric matter in different points of two globes in contact, Coulomb employed the small balance represented in Plate CCXLIV. He placed a small circle of gilt paper, Fig. 7, four or five lines in diameter, at the end of a thread of gum lac cde, fixed to a cylinder of glass or of well baked wood e b, coated with a non-conducting varnish. This cylinder moves up and down in the hole b of the piece of wood A b, and can be fixed in any position by means of the screw s. In comparing the electricity of any two points, the circle of tinsel on the needle of the balance was electrified, and the circle of gilt paper, after touching one of the points, was put into the balance, and the quantity of its electricity measured as before. The electricity of the second point was determined in a similar manner. The electricity of the first point was again determined, after an interval equal to that between the first and second observations, and the mean between the two determinations adopted as free from the effects of dissipation.

**Exp. 1. With two equal Globes each 6 Inches in Diameter.**

<table>
<thead>
<tr>
<th>Repulsive force.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Globe touched at 30° from the point of contact</td>
</tr>
<tr>
<td>Globe touched at 90° from the point of contact</td>
</tr>
<tr>
<td>Globe retouched at 30° from the point of contact</td>
</tr>
<tr>
<td>Globe retouched at 90° from the point of contact</td>
</tr>
</tbody>
</table>

Hence taking the three first observations, the density at 30° is to that at 90° as 64 to 31 or 2 to 1. Taking the three last, it is to that at 90 as 6 to 28, or 1 to 4.72

**Mean** 1 to 4.72

**Exp. 2. With the same Globes.**

<table>
<thead>
<tr>
<th>Repulsive force.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Globe touched at 60° from the point of contact</td>
</tr>
<tr>
<td>Globe touched at 90° from the point of contact</td>
</tr>
<tr>
<td>Globe retouched at 60° from the point of contact</td>
</tr>
<tr>
<td>Globe retouched at 90° from the point of contact</td>
</tr>
</tbody>
</table>

Hence taking the three first observations, the density at 60° is to that at 90° as 19 to 23 or 1 to 1.21

**Mean** 1 to 1.29
**ELECTRICITY.**

Exp. 3. *With the same Globes.* Repulsive force.

- Globe touched at 90° from the point of contact 20°
- Globe touched at 180° from the point of contact 19°
- Globe retouched at 90° from the point of contact 17°
- Globe retouched at 180° from the point of contact 18°

Hence, taking the three first observations, the density of the globe at 90° is to that at 180° as 19 to 18, or as 1 to 0.95.

Taking the last, it is to that at 180° as 18 to 17, or as 1 to 0.92.

Mean 1 to 0.95

Exp. 4. *With the same Globes.* When the globes are touched at 20°, or at any point below it, no electricity appears.

By comparing the 2d, 3d, and 4th experiments, we shall have for the ratio of the electrical densities at 20° and 90°, the mean of which and 4.72 formerly found, is 4.78.

The following Table will show at one view the results of the preceding experiments.

<table>
<thead>
<tr>
<th>Ratio of the electrical densities</th>
<th>Distances from the point of contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0°</td>
</tr>
<tr>
<td>0</td>
<td>20°</td>
</tr>
<tr>
<td>1</td>
<td>30°</td>
</tr>
<tr>
<td>3.72</td>
<td>60°</td>
</tr>
<tr>
<td>4.76</td>
<td>90°</td>
</tr>
<tr>
<td>5.05</td>
<td>180°</td>
</tr>
</tbody>
</table>

When the globes were unequal, and the one half the diameter of the other, the density of the small globe was almost nothing till the distance was 30°.

From 60 to 90 it increases in the ratio of 10 to 17.

From 90 to 180 it increases in the ratio of 75 to 100.

When the small globe was only 1/2 the diameter of the other, the density of the small globe increased.

<table>
<thead>
<tr>
<th>Increase</th>
<th>Distances from contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 0</td>
<td>0 to 30</td>
</tr>
<tr>
<td>0 — 1</td>
<td>30 — 45</td>
</tr>
<tr>
<td>1 — 4</td>
<td>45 — 90</td>
</tr>
<tr>
<td>4 — 5.72</td>
<td>90 — 180</td>
</tr>
</tbody>
</table>

In the large globe of 8 inches, the density was nothing to the 4th or 5th degrees from the point of contact. It then increased rapidly, and from 90° to 180° it was almost uniform.

From these experiments we may conclude in general, that the more the globes are unequal, the more does the density of the small globe vary from the point of contact to 180°, and the more does the distribution of the electric matter on the great globe approach to uniformity, increasing rapidly from the point of contact, where it is nothing, to the 7th or 8th degree from this point, and being uniform over all the rest of its surface.

In order to compare these experiments with the theory of the distribution of electricity after the law of the inverse duplicate ratio of the distance, Coulomb found it necessary to make some subsidiary experiments, which are well worthy of being detailed as general facts.

Exp. 1. Having placed between two electrified globes of the same size, a small globe, whose diameter was less than the sixth part of the diameter of either, so that all the three were in contact, he found that the small globe, when presented to a very sensible electrometer, gave no signs of electricity, and that however small the middle globe was it possessed no negative electricity.

Exp. 2. When three equal globes, two inches in diameter, were placed in contact in a right line, one of the globes, supported by the pincers Fig. 3, was placed successively between the two others, and on each side of both. In these different positions it was presented to the great torsion balance, and the quantity of electricity being measured, it was found, that when it was placed in the middle it took more electricity than when it was placed at either of the sides in the ratio of 100 to 134. This result is the mean of the experiments made after equal intervals, for the purpose of correcting the error arising from the dissipations.

Exp. 3. Hitherto we have seen that when two globes were in contact, the density at the point of contact and in the adjacent parts was nothing, and was never negative when the two globes were positively electrified. But the moment the two globes are separated, then if one of the globes is smaller than the other, and if the distance of the two globes is not great, the point of the little globe which was in contact with the great globe, will become negative, till they are separated to a certain distance. At this distance, the electricity is again nothing, and by increasing the distance, the same point becomes afterwards positive.

Exp. 4. Having insulated a globe of 11 inches diameter, and also another globe of a smaller size, electrify them and bring them into contact. Let the small globe be then taken to a different distance, and, by means of a very small ball of lead suspended by gum lac, or by means of a circle of gilt paper, touch the small globe at the point where it touched the great globe, and examine in the small torsion balance the nature of the electricity of that point.

When the large globe is 11 inches in diameter, and the small one 8 inches, and both positively electrified, the point of contact of the great globe is always positively electrified, whatever be the distance between the two. The point of contact of the small globe, however, will be negatively electrified, till the distance of the two is one inch. At this distance it becomes nothing, and beyond it its electricity is positive.

If the small globe is only 4 inches in diameter, the other remaining the same, the phenomena are precisely the same; but they take place at 2 inches instead of 1 inch.

When the small globe is only 2 inches in diameter, or less than 2 inches, the other remaining the same, the same phenomena take place, but at the distance of 2 inches and 5 lines.

The following Table contains some curious results, shewing the relation between the mean density D of the largest of two globes after its separation from the small globe, to the density d of the point of the small globe with which it was in contact, R being the radius of the large globe, and r that of the small one.

<table>
<thead>
<tr>
<th>Ratio of the Radii,</th>
<th>Ratio of the Electrical densities, or</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>or d/r</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1.27</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1.55</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2.35</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>3.18</td>
<td></td>
</tr>
<tr>
<td>Infinite</td>
<td>4.00</td>
<td></td>
</tr>
</tbody>
</table>
6. On the Distribution of Electricity among several Globes placed in Contact in a Line.

Exp. 1. When six equal globes of 2 inches in diameter were in one line and electrified, and then examined in the balance, Coulomb obtained the following results:

Density of the first is to that of the second as 1.00 to 1.00.
Density of the first is to that of the third as 1.50 to 1.00.

Hence, the density has been diminished one third from the first globe to the second, and only one fifteenth from the second to the third.

Exp. 2. When twelve globes 2 inches in diameter were placed in a row, and examined as before, the electric density of the first is to that of the second as 1.50 to 1.00.
Density of the first is to that of the sixth as 1.70 to 1.00.

Exp. 3. When twenty-four equal globes 2 inches in diameter were placed in a row, the electric density of the first is to that of the second as 1.60 to 1.00.
Density of the first is to that of the twelfth or middle globe as 1.75 to 1.00.

It follows from these two experiments, that whatever be the number of globes, the mean density varies considerably from the first to the second, but afterwards very slowly, from the second to the middle globe. At equal distances from the extremities of the row, the electric densities are equal, and therefore the density is always least in the middle.

7. Distribution of Electricity over several unequal Globes.

Exp. 1. When two globes 2 inches in diameter were placed in contact with one of 8 inches, the quantity of electricity of the small globe most distant from the great one, was to that of the one in contact with the great one as 2.54 to 1.00.

Exp. 2. When four globes of 2 inches were placed in contact with one of eight inches diameter, the quantity of electricity of the small globe, the most distant from the great one, was to that of the globe nearest the great one as 3.40 to 1.00.

Exp. 3. When five globes of 2 inches in diameter were placed beside another of 8 inches diameter, the ratio of the density of the fourth globe was to the mean density of the large globe as 2.08 to 1.00.

Exp. 4. When twenty-four globes two inches in diameter were placed in contact with one of eight inches, Coulomb compared the twenty-fourth, or the last small globe, with several of the others, and obtained the following results:

The quantity of electricity, or mean density of the electric matter in the 24th globe, is to that of the 23d as 1.49 to 1.00
The quantity in the 24th is to that of the 12th as 1.70 to 1.00
The quantity in the 21st is to that of the 21st or the one in contact with the large globe, as 2.10 to 1.00
The quantity in the 24th is to that of the large globe itself as 3.72 to 1.00.

This last result differs very little from that which we have found for the fourth globe, at the end of a line of four globes of 2 inches, in contact with a globe of eight inches.

8. Distribution of Electricity on the Surface of a Cylinder.

In the following experiments, Coulomb insulated a cylinder 30 inches long, and 2 inches in diameter; and having electrified it, he examined its electrical density in several places by a small circle of gilt paper as before, and obtained the following results:

The density of the middle of the cylinder is to that of its extremity as 1.00 to 2.30
The density of the middle of the cylinder is to that of a point 2 inches from the extremity as 1.00 to 1.25
The density in the middle of the cylinder is to that of a point situated in the hemisphere which terminated the cylinder at an inch from its extremity, as 1.00 to 1.80

Hence it follows, that upon the two last inches at the extremity of the cylinder, the electric density is much greater than towards the middle of the cylinder, and that it varies a little from the middle to within 2 inches of the extremity.

9. On the Distribution of Electricity between a Globe and Cylinders of different lengths, but of the same diameter.

Exp. 1. Having electrified a globe eight inches in diameter, and made it touch an insulated ball nine lines in diameter, Coulomb found its electrical force to be 154", or 150° when corrected for the dissipation. He then quickly touched the eight-inch globe with the cylinder two inches in diameter, and 30 inches long, and upon withdrawing the cylinder, he examined its electricity by the small ball as formerly, and found it to be 68°. Hence 150° of electricity were reduced to 68° by the contact of the cylinder, which therefore took 82° from the electricity of the globe, leaving it only 68°. The quantity of electric fluid, therefore, in the cylinder, is to that in the globe as 62 to 68, or as 1.21 to 1.00. Now, the superficial area of the globe is to that of the cylinder as 50 to 64; consequently, the mean density of the electric matter on the surface of the cylinder, or 1.21/64, will be to 1.00, or as 129 is to 100. This ratio may be stated more accurately as 1.30 to 1.00, which is the mean of a great number of experiments.

Exp. 2. When the cylinder was 15 or even 10 inches long, its electricity was divided with a globe of eight inches in such a manner, that their mean densities were almost exactly in the same ratio of 1.30 to 1.00, as in the preceding experiment. When the diameter of the globe, however, was very large compared with that of the cylinder, and when the cylinder had very little length, then the mean density of the cylinder, relative to that of the globe, was much less than when the length of the cylinder was considerable.

Exp. 3. When a small cylinder, five or six lines in length, and two lines in diameter, was put in contact with a globe of eight inches, the mean density of the electric fluid on the surface of the cylinder was to that of the globe nearly in the ratio of two to one; but
ELECTRICITY.

Descriptive

Electricity.

When the cylinder was only two lines in diameter, and six inches long, the mean density of the cylinder was to that of the globe as 8 to 1.

Exp. 4. When the globe was eight inches in diameter, and 30 inches long; then,

When the diameter of the cylinder was two inches, the mean density of the cylinder was to that of the globe as: 1.00 to 1.30.

When the diameter of the cylinder was one inch, the mean densities were: 1.00 to 2.00.

When the diameter of the cylinder was two lines, the mean densities were: 1.00 to 9.00.

Hence the augmentation of density follows a smaller ratio than the diameters of the cylinders.

Explanation of the action of points.

This experiment furnishes us with a beautiful explanation of the influence of points in dissipating electricity. Points may be considered as cylinders of small diameter and great length. Now, in the preceding experiments, we have seen that a cylinder two lines in diameter, and 30 inches long, had its electric density nine times greater than that of a globe. But when a cylinder was electrified and terminated by a hemisphere, the electrical density of the extremity was to that of the middle of the cylinder as 2.30 to 1.00.

Now, this ratio ought to be greater when the cylinder is very long, and has one of its extremities in contact with a large globe. Suppose, therefore, that the cylinder, two lines in diameter, has its extremity rounded into a hemisphere, the electrical density of the extremity of the axis will be to that on the surface of a globe of eight inches, as 9 x 2.30 = 20.7 to 1.00; but as the air is an imperfect electric, it follows, that in making the small cylinder touch a globe of eight inches diameter, the electric fluid ought to escape by the extremity of the cylinder, with a degree of rapidity proportional to the electrical density of the globe.

When the globes have a diameter much greater than that of the cylinder, eight times greater, for example, or, more, the electrical density of the different globes in contact with the cylinder being supposed equal to the same quantity D, the densities of the electric fluid on the surface of the cylinder, will be to one another as the diameters of the globes. If, for example, we take the globe of eight inches in contact with a cylinder of one inch, we have seen that the density of the globe being D, that of the cylinder is nearly 2 D; but if in place of the globe of eight inches, we put in contact with the same cylinder a globe of 23 inches, and whose electrical density we suppose to be D, then the mean electrical density of the fluid in the cylinder will be nearly equal to 6D.

From the preceding experiments, we may determine the ratio between the electrical density of a globe, and that of a cylinder of any diameter, touching the globe by one of its extremities. It follows, from the results in Exp. 4, that the electrical densities of different cylinders are in the inverse ratio of the power of their diameters, which approaches very much to unity when the diameter of the globe is very much greater than that of the cylinder. For different globes and the same cylinder, the density of the cylinder will be as the diameters of the globes, if their diameter is much greater than that of the cylinder. Supposing D, then, to be the density of the globe, R its radius, d the mean density of the cylinder, and r its radius, we shall have

\[ d = \frac{m \cdot DR}{r^2} \] or \[ d = \frac{m \cdot DR}{r} \]

when R is much greater than r. In this equation, the constant co-efficient \( m \) may be determined from experiments in the following manner.

When a globe four inches radius was in contact with a cylinder 30 inches long, and two lines in diameter, the mean density of the cylinder \( rd \) was \( d = 9 \). But in this case \( R = 4 \) inches, therefore \( d = 48 \); hence \( d = 48 \cdot m \), and \( m = \frac{9}{48} \) the constant co-efficient.

Coulomb has applied this result very beautifully to the phenomena of the electrical kite flying in a thunder-storm, and having its cord made to conduct by a wire, insulated at its lower extremity. The cord of the kite emits sparks with the greatest violence to all the conducting bodies in its neighbourhood. Let us suppose that the cloud charged with the electric fluid has the form of a globe 1000 feet radius; that the cord of the kite is one line in radius; then the mean density on the surface of the cord will be \( d = \frac{m \cdot DR}{r} \), and \( d = \frac{27000}{1000} \times \frac{12}{12} \times 12 \times 12 \times 12 \times 12 = 27000 \). But we have already seen, that the electrical density at the end of a cylinder terminated by a hemisphere, is to the density of the middle as 2.30 is to 100; consequently, \( d = 2 \cdot 30 \times 27000 = 62000 \) D, or 62000 times greater than the density of the fluid which is supposed to reside in the surface of the cloud. It is, therefore, not to be wondered at, that the electric fluid, in a state of such high condensation, should be emitted in sparks on every side.

Exp. 5. Having electrified positively, a globe eight inches in diameter, and also the needle of the balance, he found the electrical density of the globe to be \( 14^\circ \) by means of a small globe one inch in diameter, and then touched the globe with a circular plane 16 inches in diameter and \( \frac{1}{4} \) of a line thick, so that a diameter of the globe was perpendicular to the plane at the point of contact. He again determined the electrical density of the globe by the small one-inch globe, and found it equal to \( 47^\circ \). The electricity of the globe being reduced from \( 14^\circ \) to \( 47^\circ \), the plane obviously carried off \( 14^\circ - 47^\circ = 97^\circ \); so that the quantity taken by the plane was double that which it left in the globe. Now, since the area of a globe of eight inches in diameter, is \( 301.6 \), and the area of both the surfaces of the circular plane \( = 403.2 \), which is exactly double of the former, it follows, that the electricity is distributed between the plane and the globe, in the ratio of their surfaces.

The preceding result was obtained in a great number of other experiments made with globes and planes of different sizes; and the ratio above mentioned was always more exact when the plane was small in proportion to the surface of the globe. A plane, for example, six lines in diameter, when made to touch tangentially a globe of eight inches, takes upon each of its surfaces an electrical density equal to that of the globe, or, what is the same thing, the small plane is charged with a quantity of electricity double that of the portion of the surface of the globe which it touches.

Exp. 6. Having insulated an electrified globe A, eight inches in diameter, and also two equal globes B, C, two inches in diameter, placed at a distance from it, B being insulated upon a cylinder of glass coated, and C being insulated by a vertical support, the same as in Fig. 3.
ELECTRICITY.

If the needle of the balance and the globe A being electrified positively, the attractive force upon the needle of the globe c was found to be exactly equal to the repulsive force of the globe b.

Exp. 7. If we place an uninsulated cylinder at different distances from an electrified globe, so that its axis points to the centre of the globe, we shall have the following result: The electrical density of the extremity of the cylinder nearest to the globe, will be a little below the power 4 of the inverse ratio of the distance of this extremity from the globe.

Exp. 8. In placing successively two cylinders of different diameters at the same distance from an electrified globe, the electrical densities of the extremity of the two cylinders were to one another nearly in the inverse ratio of the diameters of the cylinders, provided that their diameters were much smaller than the diameter of the globe.

Exp. 9. In placing an uninsulated cylinder of a great length at a given distance from an electrified globe, Coulomb found that the electrical density of different points of the surface of this cylinder, were inversely as the square of the distance of these points from the centre of the electrified globe.

This law, however, does not hold upon a part of the cylinder near the globe, equal to four or five diameters of the cylinder. In this portion, the electrical density increases towards the extremity of the cylinder in a ratio much greater; and, if the cylinder is terminated by a hemisphere, the density at the extremity of the axis nearest the globe is nearly double that of a point whose distance from the extremity of the axis is equal to the diameter of the cylinder.

Exp. 10. If an uninsulated cylinder is placed at the same distance from the centre of two electrified globes of different diameters, then, supposing the electrical density of the globes to be the same, Coulomb found that the density of points of the cylinder placed at the same distance from the centre of the two globes, was as the square of the radius of the globes.

By combining the results in the four preceding experiments, Coulomb has found, that the electrical densities of a hemisphere which terminates different cylinders presented to an electrified globe, are of a contrary nature to that of the globe, and in the direct compound ratio of the density of the globe's surface, and the square of the globe's diameter, and in the inverse compound ratio of the power 4 of the distance of the centre of the globe from the extremity of the cylinder, and of the radius of the cylinder. Thus, if D be the positive electrical density on the surface of the globe, whose radius is R; r the radius of the cylinder; a the distance between the centre of the globe and the extremity of the cylinder; then, if d be the negative electrical density of the extremity of the cylinder, we shall have

\[ d = \frac{mDR^4}{r(R+a)^2}. \]

Now, the constant quantity \( m \) was found by experiment to be \( m = 2.07 \sqrt{1 \text{ inch}} \); hence, if the values of \( a, r \) and \( R \) be reduced to inches, we shall have

\[ d = \frac{2.07 DR^4}{r(R+a)^2}. \]

The application of this formula, deduced directly from experiment, to the explanation of the effects of conductors, will be pointed out in the next Chapter.

Exp. 11. If a plane, not insulated, is placed at any distance from an electrified globe, so that the electricity cannot be communicated from the one to the other but across the stratum of air which separates them, then Coulomb found that the electrical densities of a point in the centre of the plane, is of a nature contrary to that of the globe, and is inversely as the square of its distance from the centre of the globe.

CHAP. II.

On the Phenomena of Electricity produced without Excitation.

In the preceding Chapter we have endeavored to give a succinct view of the leading phenomena of electricity as produced by friction: We shall now proceed to direct the attention of the reader to a series of interesting electrical phenomena as produced without friction, either by a change of temperature, by a change of form, or by the contact of dissimilar bodies; or as exhibited in the phenomena of the atmosphere, or in the functions of living animals.

SECT. I. On Electrical Phenomena produced by a change of Temperature.

The property of exhibiting electrical phenomena merely by an increase of temperature, without the aid of friction, is possessed only by regularly crystallized minerals. The tournamal was, for a long time, the only substance which was known to be capable of this kind of excitation; but the same property has since been recognized in the topaz, in calamine or the oxides of zinc, in the borate of magnesia, and in mesotype.


The electrical properties of the tournamal seem to have been known to the ancients. The Lycurium is mentioned by Theophratus, as being a very hard body, as being used for making seals, as requiring a great labour to polish it, and as possessing the same property as amber of attracting light bodies: It is therefore highly probable that this substance was the tournamal of modern mineralogists. In the island of Ceylon, where it is very common, it is known by the name of tourmaline; and it is, first became acquainted with it in this island, gave it the appellation of Askhen-trikki, from its property of attracting ashes when it is thrown into the fire.

In the year 1717, Mons. Lemery of the Academy of Sciences, exhibited a stone from Ceylon, which he said attracted and repelled different light bodies, such as ashes, filings of iron, bits of paper, &c. in a manner different from a lodestone.‡ The experiments of Lemery were merely noticed by Linneus in his Flora Ceylonica, who mentions this stone by the name of Lapis electris.

When the Duke de Noya was at Naples in the year 1743, he was informed by the king's secretary, Count Pichetti, that he had seen at Constantinople, a small stone, called tournamal, which had the singular faculty


‡ This Paper is entitled Observations sur une pierre de l'Isle de Ceylon qui attire et repousse diverses corps, mais d'une maniere differente de l'oiimon.
of attracting and repelling light bodies. The Duke had completely forgotten this circumstance, till the year 1758, when he happened to see some tourmalins in Holland. He immediately purchased these stones, and, in company with Messrs Daubenton and Adanson, he made a number of experiments with them, of which he has published a particular account.

Before these experiments, however, were made, M. âœpinus had been informed by Lechman of the electrical properties of the tourmalin, and had received from him two crystals, on which he made a variety of experiments, which were published in the Memoirs of the Academy of Berlin for 1756, under the title of De quibusdam experimentis electricis notabilioribus. A series of more correct experiments were performed by Mr Benjamin Wilson, with several fine crystals belonging to Dr Heberden; and the subject was prosecuted by Dr Priestly in 1766, with the same tourmalins which had been used by Mr Wilson.

The tourmalin crystallizes in prisms usually of nine plane sides terminated by summits, with three, six, nine, or more faces, and are either of a green or blue colour. At the ordinary temperature of the atmosphere, the tourmalin may be electrified by friction, and the electricity which it thus acquires is always resonious; and when two tourmalins are rubbed against each other, the one is electrified positively and the other negatively.

If we apply different parts of a tourmalin, when excited by a heat between 291° and 212° of Fahrenheit, according to lepineus, to a delicate electrometer, it will be so excited as to exhibit two poles coinciding with the summits of the prism, and one of them possessing positive and the other negative electricity.

If one of the poles of the tourmalin be held near light bodies, such as grains of ashes or saw-dust, these minute bodies will be attracted to the stone, and sometimes repelled as soon as they have touched it.

When two tourmalins are presented to one another, so that the two positive or the negative poles are towards each other, they will mutually attract one another; but if two opposite poles are presented to one another, they will mutually repel each other. In order to make this experiment with success, the two crystals should be either balanced on a fine pivot, or suspended by a delicate fibre, or, what is the simplest method, floated upon two pieces of cork. When the two tourmalins are heated, tie one of them upon a flat piece of cork, and present to one of its poles the two poles of another tourmalin in succession. When two similar poles are towards each other, the floating tourmalin will turn round and present the opposite pole; and when two opposite poles are presented to each other, the floating tourmalin will follow the other in all its motions, just like a floating needle guided by the action of a magnet.

Mr Wilson kept a flat tourmalin about half an hour in a strong fire, but could not perceive any diminution of its electrical property; though he repeated the experiment with another tourmalin. When he brought the stone, however, to a red heat, and plunged it suddenly in cold water, it was not broken to pieces, but had the appearance of being shattered, and lost entirely its electrical property. M. Hauy, however, has found, that when the stone is more and more heated, there is a time when it will cease to yield signs of its electric virtue; and after withdrawing it from the fire, he often found it necessary to leave it to return to a moderate temperature, before it exhibited any action upon the little bodies that were presented to it. "It would seem," says that ingenious mineralogist, "that beyond the time where its electricity has become insensible through the action of too strong a heat, there is another where its effects are reproduced in an inverse sense. We have caused the foci of two burning glass-es to fall upon the extremities of a tourmalin, and have observed that each pole, after having acquired its ordinary electricity, would next cease to act, and lastly, would pass to the opposite state, so that the attraction, after having become zero, would give place to repulsion or reciprocally."

The experiments made by Canton, respecting the effect of heat upon the tourmalin, differ from those of Mr Wilson, and the Abbe Hauy. Having put a tourmalin of the common colour into the fire, and burnt it white, he found that its electrical property was completely destroyed. Another tourmalin, heated in a similar manner, lost only part of its electricity. Two tourmalins when softened by heat, were joined together without losing their electrical property. The polarity of another was increased by having one of its ends melted; and another tourmalin retained its electrical property, after being plunged into cold water when red hot.

To the Abbe Hauy we are indebted for a very beautiful discovery respecting the tourmalin. He found that the electrical density diminishes rapidly from the summits or poles towards the middle of the crystal, and is almost nothing throughout a sensible space towards the middle of the prism. The greatest density which resides in the negative and positive poles, is near the summits. This singular distribution of the electric matter is almost exactly the same as in a cylinder: (See Sect. xi. Art. 8.) In order to observe this property, present the tourmalin to the electrified needle of one of Coulomb's delicate electrometers, or to an insulated electrified needle, finely balanced upon a pivot, and the needle will always be observed to have a marked tendency to one point of the stone, but when the needle points to the middle of the prism, so that it is equidistant from the two poles, the needle will have no motion except a mere fluttering. The following curious experiment is given by the Abbe Hauy. "Let T," says he, "be a tourmalin, having its centre of resinous action placed at A, and its centre of vitreous action at a. Take a stick of sealing wax, at the end of which there is fixed a silk thread of about a centimetre, or four and a half inches in length, by heating the wax at that end, and inserting one extremity of the thread in the part thus melted. If after having rubbed the sealing wax, in which case the free extremity of the thread will acquire resinous electricity, that same extremity be brought in presence of the point R of the tourmalin, and if, at the same time, the latter be made to receive little alternate motions from right to left, and reciprocally, the thread will be seen to bend itself in a contrary direction to avoid the point R; and if the stick be brought a little nearer the tourmalin, the thread will incline all at once, by a curvilinear motion towards the point A. If we afterwards present to the thread the points situated a little beyond A, and all the succeeding ones, between that and the opposite extremity U, attractions will be manifested throughout. But if a thread possessing vitreous electricity be employed, such as that which should be attached to a glass tube, which had been rubbed, on presenting it towards the extre-
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If a tourmalin, when in a state of excitation by heat, is broken into two parts, however small, each fragment has two opposite poles, a phenomenon analogous to what takes place in a broken magnet. Mr. Canton cut a large irregular tourmalin into three pieces, and a piece being cut from the positive, and another from the negative pole, the outer side of the piece which he cut from the negative pole was negative when cooling, and the outer side of the piece which he cut from the positive pole was positive while cooling, the opposite ends of all the pieces possessing a contrary electricity. The middle piece had the same properties as in the outer tourmalins, the positive end remaining positive, and the negative end negative. He obtained the same results from two other tourmalins that had been cut out of a large one. Dr. Priestley, who broke a tourmalin by accident into three fragments, one of which was 96 grains, another 10 grains, and another one grain, found that the largest fragment was not injured by the accident, and its two poles were unaltered.

Mr. Canton found, that if A was the positive pole, and B the negative pole, when a tourmalin was excited by heat, then when the tourmalin was not electrical, but became so by cooling, the pole A was negative, and the pole B positive. Having placed a small tin cup of boiling water on one end of his electrometer, which was supported by warm glass, while the pith balls were at the other end, he dropped a tourmalin into the water, and observed, that during the whole time of its being heated, and likewise during the operation of cooling, the balls were not at all electrified. This result seems, in some measure, to be contrary to the experiment of Mr. Wilson, who covered all his tourmalins with grease, and when each of them was so warm as to preserve the grease liquid, he found their electrical property only a small degree weakened.

The following curious experiment was made by Mr. Wilson. Having brought to a red heat one end of a glass tube, and exposed to it the negative pole of a tourmalin, about three inches of the heated part of the glass was electrified negatively, and all the glass beyond it positively; and this property continued even after the glass was cold. The positive side of the tourmalin was then applied to the same piece of heated glass; he found that the tube was electrified negatively from foot to foot, without the least appearance of positive electricity beyond it, and this negative electricity continued when the glass was nearly cold.

Dr. Priestley made a number of curious experiments with the large tourmalin, which had been used by Mr. Wilson and Mr. Canton, and which had a convex and a flat side; the convex side being always positive in cooling, and the flat side negative. In these experiments, Dr. Priestley placed the tourmalin upon a pyrometer heated by a spirit lamp, in order to ascertain with accuracy whether the temperature was increasing, decreasing, or stationary. Dr. Priestley began his experiments by laying the tourmalin on a plate of glass, and he found that the glass had acquired an electricity equal and contrary to that of the side of the tourmalin, which was in contact with it. A positively electrified feather, for example, was always repelled at the distance of two inches by the flat side of the stone when its heat was increasing, while the glass attracted the feather at the same or even at a greater distance. When the heat was decreasing, the tourmalin attracted the feather, and the glass repelled it at the distance of four or five inches. When the temperature, from increasing, began to decrease, the electricities were often reversed in less than a minute.

Dr. Priestley now tried the effect of heating and cooling the tourmalin in contact with non-conductors and conductors, and hence he was led to a method of reversing all the experiments that have been made upon the tourmalin, so that he could make the electricity of any pole just what he chose, by the application of proper substances.

Instead of the piece of glass already mentioned, Dr. Priestley used a tourmalin, which he found to be affected exactly like the glass.

He next imbedded the negative side of a tourmalin in hot sealing-wax, and when taken out of the wax it had positive, while the wax had negative electricity. The half of the tourmalin which was not in the wax was affected as if it had been in the open air, so that in cooling both sides were positive.

When the tourmalin was cooled in mercury contained in a cina cup, it was always positive when taken out, while the mercury was left negative.

Having fastened the convex side of the large tourmalin to the end of a stick of sealing wax, he allowed it to cool, and then pressed the flat side of it pretty hard against the palm of his hand, and found it to be strongly negative, contrary to what it would have been if exposed to the open air. The stone continued negative till it acquired all the heat that it could receive from his hand, when its power decreased without changing the nature of its electricity. The stone was then allowed to cool in the open air, and it became more strongly negative till it was quite cold. Hence the same side of the stone was negative, both in heating and cooling.

Dr. Priestley then heated the flat side by holding it near a red hot poker, and then touching it with the palm of his hand, and found it to be strongly positive; allowing it to cool in the open air it became negative; and by again touching it with his hand, it again became positive. In this way he made the same side of the stone alternately positive and negative for a considerable time; and when the heat was such, that he could keep it in his hand, it acquired a strong positive electricity, which continued till it was brought to the heat of his hand. Analogous results were obtained by fastening the wax to the flat side of the stone, and using the convex side.

Dr. Priestley made a tourmalin very hot, and having covered it all over to the thickness of a crown-piece with melted sealing-wax, he found that its electrical virtue was as powerful when enveloped in this coating as when exposed to the open air. Having tied the tourmalin in a silk thread, which only touched the edge of it on both sides, he suspended it before a fire, so that it might be heated equally in every part; when it was so hot that he could hardly bear to handle it, he allowed it to remain in the same situation a quarter of an hour, in order to be certain that the heat was equally diffused. By means of a bundle of fine thread which had for some time been held in the same degree of heat, he took off the electricity which the stone had acquired, and continuing it in the same situation, he found that...
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it did not receive any new electricity from the heat. Hence he was satisfied of the truth of Mr Canton's remark, that the electricity of the tourmalin derives its electricity, not from heat, but from the circumstance of its changing its temperature. In the same way Dr Priestley confirmed another observation of Mr Canton, that when the tourmalin was heated and allowed to cool without either of its sides being touched, the two sides will retain the same kind of electricity during the whole time of the heating and the cooling of the tourmalin. On some occasions the stone often changes its electricity very slowly, and the electricity which it acquires from diminution of temperature continues many hours without any very sensible increase. In some cases, the electricity acquired by heating may be so strong as to overpower the virtures acquired by cooling, so that both sides of it may exhibit the same kind of electricity during the whole operation. Hence Dr Priestley accounts for the mistake of the Duke De Noya, who asserted, in opposition to Aepinus, that both sides of the tourmalin acquired in every case a positive electricity.

Although the property which the tourmalin possesses of becoming electrical by heat, is strongest in transparent crystals, yet the black and opaque crystals often possess the same property in a high degree. In some crystals, however, which are rendered impure, by the admixture of particles of iron and other bodies, the electricity is very feeble, and sometimes imperceptible. In such cases, the Abbé Hauy frequently found that a fragment detached from the mass possessed polarity when it was not exhibited by the entire crystal, and when the fragment was taken from the part which approached most to the vitreous state. Hence mineralogists have committed a great mistake, in dividing the tourmalin into those which are electrical and those which are opaque. M. Emmerling, in his Treatise on Mineralogy, has attempted to make a different distinction, by maintaining that the electrical shool or tourmalin, is the only one which loses its electrical property by being too much heated. M. Hauy has carefully examined this supposition, and has found that green as well as black tourmalin retain their virtue after being brought to a red heat. He found also, that when the heat was very great, both the electrical and the black school were deprived of their polarity.


3. On the Electricity of the Borate of Magnesia.

In the year 1791, M. Hauy obtained two crystals of that species of the boracite or borate of magnesia, which he calls defective, (Magnesia Boraté Defective; see our article Crystallography, vol. vii. p. 474. col. 2.) He exposed them to the heat of the fire, and presented them to an electrometer. * He immediately perceived that it was electrified, and that it had several poles endowed with opposite electricities. He experienced at first considerable difficulty in determining the precise position of these poles, both from the delicacy of the experiment, and from the extreme smallness of the crystals. By comparing, however, the crystals with the tourmalins, he reasoned in the following manner: As in the case of the tourmalin, there was only one axis which coincided with that of the nucleus, there ought only to be two electrical poles situated at the extremity of this axis in the cube, on the contrary, which was the nucleus of borate of magnesia, there were four axes, each of which passed through the solid angles, and consequently there ought to be 8 electrical poles, one at the

* This electrometer will be described in Part II. of the present article.
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On the electricity of the borate of magnesia, is, in general, perceptibly weaker than that of the tournalin; and in repeating the experiments of Hauy, particularly those which relate to the poles that exercise a repulsive force, the small needle, negatively electrified, must be directed to the negative pole; for as the repulsive forces are limited to a very small space, the least deviation of the negatively electrified needle will cause it to be attracted by the adjacent parts of the stone, which are nearly in their natural state of electricity.

M. Hauy likewise found that the centres of action of the poles of this mineral are situated very near the extremities of the axes, and that from these poles the electrical density diminishes rapidly, and disappears in other parts of the crystal, a result which he had before obtained from the tournalin. See Hauy Annales de Chimie, tom. ix. p. 59, &c.; Hauy Ann. de Mus. xvi. p. 1.; Hauy Traité de Mineralogie, tom. ii. p. 342.; and Traité de Physique, tom. i. See also Art. 6. of the present Section.

4. On the Electricity of Mesotype.

This mineral is a species of zeolite, and was found by M. Hauy to possess the property of being excited by electricity. Unfortunately he could not obtain complete crystals; but having detached from its support a crystal about 5¼ lines in length, he heated it, and presented it to a silk thread negatively electrified. The thread was instantly attracted by the pyramidal summit of the crystal, and repelled by the fractured part; hence it follows, that the pyramidal summit possessed negative electricity. Stillbite is not electrical by heat.


5. On the Electricity of Calamine.

This mineral has been long found in the mines of Spath seleniteus, and was mistaken for zeolite by several mineralogists, till M. Pelletier * proved that it was crystallized calamine. M. Hauy, so early as the year 1785, discovered the electrical property of this mineral, which is the more remarkable as it belongs to the class of metallic substances.

The crystals of calamine are so easily excited, that their polarity appears in two or three seconds after they are exposed to a fire or to the flame of a candle, and they often retain this polarity several hours after they are cold. In one group of these crystals, sensible indications of electricity were distinctly visible twelve hours after they were cold, while a tourmalin, excited at the same time, had lost all its polarity in the course of a single hour. In another species of calamine, where the crystals were similarly grouped, but presented points of octahedrons, Hauy found the same electrical property. See Hauy, Mem. Acad. Par. 1785, p. 207.; and Hauy Traité de Mineralogie, vol. iv. p. 164.


We are wholly indebted to M. Hauy for the fine discovery that the polarity which minerals receive from heat, is related to the form of their secondary crystals.

The opposite and corresponding sides of crystals are in general similar, both with respect to the number, the disposition, and the figure of their faces. The forms of crystals, however, that become electrical by a change of temperature, deviate from this symmetry of form; so that the poles or parts of the crystal where the opposite electricities reside, although they are similarly situated at the two extremities of the secondary crystal, yet they differ in their configuration; "one of them undergoing decrements which are consequent upon the opposite part, or to which decrements correspond that are subjected to another law, a circumstance which may enable an observer to predict before hand, simply from the inspection of the crystal, on what side either species of electricity will be found; when the crystal shall be submitted to the test of experiment. Thus in the variety of the tournalin which we shall call isogone, and which is represented by Fig. 5, the shape is that of a prism of nine plane sides, terminated at one end by a summit having three faces, and at the other by a summit having six faces; and experiments prove, that the first summit is the seat of resinous electricity, while the second manifests vitreous electricity.

In the new variety of topaz crystals, viz. the octosex-detenimal amethystate of silesia, M. Hauy has recently detected the same deviation from the rules of symmetry in the secondary form of its crystals. Owing probably to the imperfect state of these crystals, he has not been able to observe the same phenomena in the secondary forms of mesotype and calamine.

But of all the crystals that exhibit this co-relation between the exterior configuration and the electric virtue, the most remarkable are those which appertain to an acidulating substance, named borate of magnesia, whose form is generally that of a cube incomplete in all its edges, and farther modified by facets corresponding to the solid angles. Here the two electricities act according to the directions of four axes, each of which passes through two opposite solid angles of the cube, which is the primitive form. In one of the varieties, Fig. 6, which we shall call defective, one of the two solid angles situated at the extremities of the same axis is entire; the other has given way to a facet r. Now resinous electricity is evinced at the angle, which has not undergone any alteration; and vitreous electricity at the facet, which supplies the place of the opposite angle; thus making eight electric poles, four for each species of electricity. In another variety, Fig. 7, the solid angles analogous to those of the preceding which were supplied by the facet, continue to present the same modification. The other angles situated similarly to those which were entire, are here replaced each by a like facet s; but if it existed alone, the symmetry would be found re-established, while the law of the phenomenon requires that it should be altered. Therefore, three other facets r, r, s, are observed to be situated about each of the former; so that the angles which they modify, present in this respect a kind of superabundance, in consequence of which this variety has been denominated superabundant borate of magnesia.


* Journal de Physique, December 1783.
Sect. II. On the Electricity produced by the melting of
Resinous Bodies.

ELECTRICITY.

Mr. Stephen Gray was the first person who observed that electricity was produced, when bodies merely changed their form. He made his experiments with black and white rosin, stone pitch, shell or gum lac, bees wax, and sulphur. These bodies were compounded in different ways, so as to form the substances in the following Table: the first column of which contains the name of the substance, either simple or compound; and the second its weight.

Names of the Substances. Weight.
1. Fine black rosin 20
2. Stone pitch and black rosin 22
3. Fine rosin and bees wax 21
4. Stone pitch 17
5. Stone sulphur 30
6. Shell lac 100
7. Fine black rosin 104
8. Bees wax and rosin 90
9. Rosin 4, and gum lac 1 part, 100
10. Sulphur 180
11. Stone pitch 1012
12. Black rosin 230
13. White rosin 712
14. Gum lac 1114
15. Gum lac and black rosin 912
16. Gum lac 4 parts, rosin 1 part 178
17. Shell lac, fine black rosin 234
18. A cylinder of stone sulphur 194
19. A large cake of stone sulphur 300
20. A cake of sulphur 114

All the bodies in the preceding Table, excepting Nos. 18 and 19, were prepared in the following manner: They were melted in the proper quantities in iron ladles, and as soon as they were taken off the fire, they were set by to cool and harden. The ladle was then placed on the fire for a short time, till the substance was melted at its bottom and sides, and, by inverting the ladle, the substance was easily taken out, and had the form of nearly the section of a sphere, both the convex and the plane surfaces being polished in cooling.

When any of these substances were taken out of the ladle, and their convex surfaces hardened, they did not exhibit any electrical indications, till their temperature was diminished to nearly that of a hen's egg when newly laid. The electricity gradually increased, and when they were cold, it was nearly 10 times greater than at the preceding temperature. In order to preserve these bodies in a state of attraction, he wrapped up the larger ones in white flannel, or black worsted stockings; and the smaller ones in white paper, and placed them all in a large fir box.

The cylinder of sulphur, No. 18, was formed by melting the sulphur, and pouring it into a cylindrical glass vessel, which had been previously heated to prevent it from cracking. As soon as the sulphur was hardened, it fell out of the glass by inverting it, from having contracted during cooling, and had a surface as perfectly polished as the glass itself. The large cone of sulphur was made in a similar manner, by melting the sulphur in a large drinking glass. Mr. Gray examined all the bodies 30 days after they were made, and found that they attracted as vigorously as they did at first, and some of them did not lose their attraction till after 4 months. The cone of sulphur, No. 19, began to attract about two hours after it was taken out of the glass; and the glass itself attracted likewise, but very feebly. On the following day, when the sulphur was taken out of the glass, its attraction was very strong, and that of the glass imperceptible. The cone of sulphur was in these cases placed with its base on the top of the fir box, where the other electric bodies lay, and the glass placed over it; but finding this place inconvenient, Mr. Gray removed it to the table, between the two windows of his chamber, and whenever the glass was taken off, it attracted at as great a distance as the sulphur. Afterwards, the glass attracted at a less distance than the sulphur. The cake of sulphur, No. 20, was laid with its flat side downwards upon a table, and though it had no covering of any kind upon it, the attraction of this, as well as that of the other substances, always varied with the weather; but the attraction of the cake of sulphur was never more than one-tenth of that of the cone. Mr. Gray observed all these attractions, by the action of the electrical bodies upon a fine white thread tied to the end of a stick.

Experiments similar to those of Mr. Gray were made by M. Wilcke of Rostock, who called the electricity which was in this way produced, spontaneous electricity. Wilcke made experiments on the same subject; but as we have already given a sufficiently full account of these in our History of Electricity, p. 423, 424, it is needless to repeat them in this place.

Mr. Henley repeated the experiments of Mr. Gray, and obtained nearly similar results. He discovered that electricity was exhibited by chocolate, when it was cooled in the tin pans into which it is received. At first the electricity is strong, and it is retained for some time after it is taken out of the pans, though it soon loses it by handling. When it is again melted and allowed to cool, the electrical virtue is restored, but not to its former strength. After the third or fourth melting, however, the electricity is extremely weak. When the chocolate is mixed with a little olive oil before it is poured out of the pan, it then becomes strongly electrical.

These experiments of Mr. Henley were repeated and verified, in 1784, by M. Pabst, and in 1787 by M. Liphardt of Konigsberg. The last of these writers being at one time occupied in preparing chocolate, placed some cakes upon one another, and having held a bundle of silk threads within two inches of them, they were attracted with great velocity, and adhered to the cakes. M. Liphardt also found that tallow melted and cooled gave electrical symptoms. Thinking that electricity could not be produced without friction of some kind, M. Liphardt took four ounces of warm and liquid chocolate, and having placed them upon an iron plate, he brought near the silk threads, but observed no indications of electricity. He then put the mass into shape, and having struck it well against a flat surface, as is the custom in extending the chocolate, he took it warm out of the shape, and found it to be electrical.

M. Liphardt made also some experiments on the electrical effects produced by a sudden blow. He let fall a piece of sealing-wax, from the height of 8 inches, upon a table, and repeated this from 10 to 20 times, when it exhibited marks of electricity. Gun copal

* See Phil. Trans. 1737, vol. xxxvii. p. 293.
From these experiments their ingenious authors conclude, that the electricity is produced by the friction which the electrical bodies undergo when they are spread upon the surfaces of other bodies upon which they are poured when in a liquid state.

M. Chapital discovered, that electricity was developed during the congelation of glacial phosphoric acid. The same property has been found in calomel, when it fixes by sublimation to the bottom of a glass vessel.


Sect. III. On the Electricity produced by Evaporation.

We have already seen in our History of the Science, that Laplace, Lavoisier, and Volta discovered that electricity was generated during the evaporation of various fluids.

In their experiments they made use of two different kinds of apparatus. In both of these, the bodies that were evaporated were insulated by means of stands of glass coated with sealing wax. When the disengagement or the absorption of the electric matter was believed to be instantaneous, the body was made to communicate directly with the electrometer by means of a chain or a thread of arcell; but when the electric matter was supposed to be disengaged slowly, and continued for a certain time, they made use of Volta's condenser, which has the property of accumulating small quantities of electric matter.

Having put iron filings into a vessel with a large aperture, they poured upon them sulphuric acid weakened with three parts of water. After a brisk effervescence, and the rapid disengagement of inflammable air, the condenser was so powerfully electrified, that it afforded a lively spark, and they found from the electrometer that the electricity was negative.

When sulphuric acid was, in like manner, thrown into some vessels that contained powdered chalk, fixed air was rapidly disengaged, and the condenser and electrometer indicated that the electricity was negative. It was, however, less than in the preceding experiment, and produced no sensible spark.

When nitrous gas was produced, they obtained a similar result; but in order to increase the electricity, they used six vessels at once, each containing iron filings, and they poured over them nitrous acid dissolved with about two parts of water. The effervescence and the production of air were extremely rapid, and negative electricity was distinctly produced; but as the circumstances under which the experiment was made were not favourable, the electricity was very weak. Three small clay vessels filled with burning charcoal were next insulated, and made to communicate with Volta's condenser.

The negative electricity which was generated was so sensible, that by augmenting the quantity of charcoal they could easily have obtained from it a spark.

The next experiments were made upon the evaporation of water, produced by throwing it upon three insulated furnaces of hampered iron, which communicated with the electrometer. In three successive experiments the electricity was distinctly perceptible. In
In order to account for the positive electricity generated in the first experiment, M. Saussure conjectured that the intensity of the heat to which the water was exposed by the contact of a body brought to a white heat, was the cause of the electricity produced by the evaporation, and that a combination was then formed, by which a new quantity of the fluid was developed. The quantity of electricity was so great in the experiment, that the balls of the electrometer were separated to the greatest possible distance. In order to verify this conjecture, that the electricity was produced in some way or other by the combustion of the water or the iron, Saussure tried to procure positive electricity, by moderating the heat of the iron. Into a large insulated iron crucible, five inches high, four in diameter, and six lines thick, and made red-hot, he threw small quantities of water successively, till the crucible had the degree of heat sufficient to make water boil. The electricity produced at each projection of the water was carefully observed, and destroyed. The electricity which was exhibited was always positive. It was very strong at the first projection, and gradually diminished to the twelfth, when it was scarcely perceptible. In the repetition of this experiment, Saussure found that when a small quantity of water was thrown into the crucible the moment it was taken from the fire, and while it had a pale red colour approaching to white, he could not obtain any indication of electricity.

In order to examine the relations which existed between the periods of evaporation and the production of electricity, M. Saussure made a great variety of experiments. His apparatus consisted of a well-baked vessel of clay, 4 inches in diameter, and 15 lines thick, which he insulated upon a clean and dry goblet of glass. Upon the vessel of clay he placed a crucible, or any other body powerfully heated, and by means of a wire he connected this crucible with the electrometer. Fifty-four grains of distilled water were thrown upon the heated crucible, and by means of a time-piece and an electrometer he observed the period of evaporation, and the degree of electricity that was produced. The results which he obtained are given in the following Tables.

The first column of all the tables contains the number of projections of water that were made. The second the number of minutes and seconds that had elapsed from the commencement of the experiment, or from the time of the first projection to that of the corresponding projection. The third column expresses in seconds the time which was necessary to reduce the 54 grains of distilled water to the state of vapour. The fourth expresses in lines and tenths of a line, the distance of the balls of the electrometer. The fifth marks the character of the electricity which was produced; and the sixth contains general remarks on the state of the crucibles, the vapours, and the noise which was made during evaporation. This noise undergoes great variations. It is almost nothing when the metal is very hot, and it increases as the metal becomes colder, and dissipates more readily the projected fluid.

The following Table contains the results which were obtained, when the crucible was made of forged Iron, 2½ inches in diameter, 22 lines high, 2½ lines thick, and weighing 25½ ounces.

**Table I.** Shewing the Electricity produced by the Evaporation of Water placed on a heated Crucible of Iron.

<table>
<thead>
<tr>
<th>Number of Projections</th>
<th>Time of the Evaporation</th>
<th>Duration of the Evaporation</th>
<th>Degree of Electricity</th>
<th>Character of the Electricity</th>
<th>General Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 0</td>
<td>19</td>
<td>0 0</td>
<td>Positive</td>
<td>The crucible of a lively red, and the noise very little.</td>
</tr>
<tr>
<td>2</td>
<td>0 30</td>
<td>31</td>
<td>0 0</td>
<td>Positive</td>
<td>Idem. no vapour visible.</td>
</tr>
<tr>
<td>3</td>
<td>1 30</td>
<td>35</td>
<td>0 8</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>4</td>
<td>2 30</td>
<td>31</td>
<td>0 5</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>5</td>
<td>3 30</td>
<td>27</td>
<td>0 2</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>6</td>
<td>4 30</td>
<td>25</td>
<td>0 2</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>7</td>
<td>5 30</td>
<td>20</td>
<td>1 3</td>
<td>Negative</td>
<td>Idem.</td>
</tr>
<tr>
<td>8</td>
<td>6 30</td>
<td>13</td>
<td>1 8</td>
<td>Negative</td>
<td>Idem.</td>
</tr>
<tr>
<td>9</td>
<td>7 30</td>
<td>10</td>
<td>1 7</td>
<td>Negative</td>
<td>Idem.</td>
</tr>
<tr>
<td>10</td>
<td>8 30</td>
<td>7</td>
<td>0 7</td>
<td>Negative</td>
<td>Idem.</td>
</tr>
<tr>
<td>11</td>
<td>9 30</td>
<td>6</td>
<td>0 6</td>
<td>Negative</td>
<td>Idem.</td>
</tr>
<tr>
<td>12</td>
<td>10 30</td>
<td>4</td>
<td>0 4</td>
<td>Negative</td>
<td>Idem.</td>
</tr>
<tr>
<td>13</td>
<td>11 30</td>
<td>3</td>
<td>0 3</td>
<td>Negative</td>
<td>Idem.</td>
</tr>
<tr>
<td>14</td>
<td>12 0</td>
<td>2</td>
<td>0 2</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>15</td>
<td>13 0</td>
<td>3</td>
<td>0 3</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>16</td>
<td>13 30</td>
<td>3</td>
<td>0 1½</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>17</td>
<td>14 0</td>
<td>3</td>
<td>0 1</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>18</td>
<td>14 30</td>
<td>5</td>
<td>0 5</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>19</td>
<td>15 0</td>
<td>8</td>
<td>0 4½</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>20</td>
<td>16 0</td>
<td>3</td>
<td>0 1½</td>
<td>Positive</td>
<td>Idem.</td>
</tr>
<tr>
<td>21</td>
<td>17 0</td>
<td>118</td>
<td>0 0</td>
<td>Positive</td>
<td>The noise diminishes.</td>
</tr>
</tbody>
</table>
In making another experiment with the same crucible, Saussure obtained very different results, as will be seen from the following Table, although he took every precaution to repeat the experiments under the very same circumstances.

**TABLE II.** Shewing the Electricity produced by the Evaporation of Water placed on a heated Crucible of Iron.

<table>
<thead>
<tr>
<th>Number of Projections</th>
<th>Time of the Projection (Min. Sec.)</th>
<th>Duration of the Evaporation (Seconds)</th>
<th>Degree of Electricity (Lines. Tenth.)</th>
<th>Character of the Electricity</th>
<th>General Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 0</td>
<td>7</td>
<td>0 0</td>
<td>Positive</td>
<td>Crucible a lively red, little noise.</td>
</tr>
<tr>
<td>2</td>
<td>0 40</td>
<td>5</td>
<td>0 4</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>3</td>
<td>1 20</td>
<td>5</td>
<td>3 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>4</td>
<td>1 50</td>
<td>10</td>
<td>3 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>5</td>
<td>2 40</td>
<td>11</td>
<td>2 7</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>6</td>
<td>3 40</td>
<td>13</td>
<td>2 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>7</td>
<td>4 40</td>
<td>13</td>
<td>1 7</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>8</td>
<td>5 40</td>
<td>11</td>
<td>3 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>9</td>
<td>6 40</td>
<td>9</td>
<td>1 2</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>10</td>
<td>6 40</td>
<td>8</td>
<td>1 2</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>11</td>
<td>7 10</td>
<td>7</td>
<td>1 2</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>12</td>
<td>8 10</td>
<td>6</td>
<td>0 1</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>13</td>
<td>8 40</td>
<td>5</td>
<td>0 3</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>14</td>
<td>9 10</td>
<td>4</td>
<td>0 2</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>15</td>
<td>9 40</td>
<td>3</td>
<td>0 2</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>16</td>
<td>10 10</td>
<td>3</td>
<td>0 2</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>17</td>
<td>10 40</td>
<td>2</td>
<td>0 2</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>18</td>
<td>11 10</td>
<td>2</td>
<td>0 1</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>19</td>
<td>11 40</td>
<td>3</td>
<td>0 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>20</td>
<td>12 10</td>
<td>4</td>
<td>0 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>21</td>
<td>12 40</td>
<td>6</td>
<td>0 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>22</td>
<td>13 10</td>
<td>15</td>
<td>0 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>23</td>
<td>14 10</td>
<td>120</td>
<td>0 0</td>
<td>Idem.</td>
<td>The noise ceases.</td>
</tr>
</tbody>
</table>

The following experiments were made with a crucible of Copper, three inches and three lines in diameter at top, and two inches in diameter at the bottom, three inches high, four lines thick, and weighing 57 ounces.

**TABLE III.** Shewing the Electricity produced by the Evaporation of Water placed on a heated Crucible of Copper.

<table>
<thead>
<tr>
<th>Number of Projections</th>
<th>Time of the Projection (Min. Sec.)</th>
<th>Duration of the Evaporation (Seconds)</th>
<th>Degree of Electricity (Lines. Tenth.)</th>
<th>Character of the Electricity</th>
<th>General Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 0</td>
<td>109</td>
<td>0 0</td>
<td>Positive</td>
<td>Crucible lively red, the water turning round without noise or vapour.</td>
</tr>
<tr>
<td>2</td>
<td>2 25</td>
<td>225</td>
<td>2 5</td>
<td>Idem.</td>
<td>Crucible almost black, the water turning round as before.</td>
</tr>
<tr>
<td>3</td>
<td>6 15</td>
<td>165</td>
<td>3 3</td>
<td>Idem.</td>
<td>Little noise.</td>
</tr>
<tr>
<td>4</td>
<td>9 50</td>
<td>352</td>
<td>1 2</td>
<td>Idem.</td>
<td>Noise, and vapour visible.</td>
</tr>
<tr>
<td>5</td>
<td>11 0</td>
<td>11</td>
<td>6 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>6</td>
<td>11 35</td>
<td>8</td>
<td>0 5</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>7</td>
<td>12 25</td>
<td>4</td>
<td>0 5</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>8</td>
<td>13 0</td>
<td>3</td>
<td>0 3</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>9</td>
<td>13 35</td>
<td>3</td>
<td>0 2 1</td>
<td>Idem.</td>
<td>Great noise and great vapour.</td>
</tr>
<tr>
<td>10</td>
<td>14 5</td>
<td>3</td>
<td>0 2 1</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>11</td>
<td>14 35</td>
<td>6</td>
<td>0 2 1</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>12</td>
<td>15 10</td>
<td>17</td>
<td>0 2 1</td>
<td>Idem.</td>
<td>The noise diminishes.</td>
</tr>
<tr>
<td>13</td>
<td>16 0</td>
<td>400</td>
<td>0 2 1</td>
<td>Idem.</td>
<td>The evaporation terminates without ebullition.</td>
</tr>
</tbody>
</table>

In the preceding Table, the electricity is still always positive, and is strongest when the time of evaporation is a mean between the shortest and longest times. When the copper was very much heated, the water, where it came in contact with the metal, was convex like a surface of mercury or glass. Sometimes the water appeared immoveable; at other times it turned horizontally upon itself with great velocity; and at other times threw from one of its points a little jet accompanied with a hissing noise, as if that point alone had been touched by
A heated body. In a second experiment made with the same Copper crucible, and under the very same circumstances, the electricity was at first negative at the end of the first projection, but afterwards became positive, and remained so till the experiment was completed.

In order to make the experiment with a metal that was not altered by the contact of water, Saussure employed a crucible of very pure Silver, 2 3/4 inches in diameter at top, 1 1/4 inch in diameter at bottom, 1 1/4 inches high, 1 1/16 line thick, and weighing 10 ounces.

| Table IV. Showing the Electricity produced by the Evaporation of Water placed on a heated Crucible of pure Silver. |
|---|---|---|---|---|
| Number of Projections | Time of the Projection | Duration of the Evaporation | Degree of Electricity | Character of the Electricity | General Observations |
| | Min. Sec. | Seconds | Lines. Tenths | | |
| 1 | 0 0 | 306 | 0 0 | Negative. | The crucible of a lively red colour; at first a small whistling noise, then silence, and a continual turning round of the water. |
| 2 | 5 30 | 73 | 0 3 | Idem. | Whistling noise, crackling, and vapour. |
| 3 | 7 30 | 19 | 0 2 | Idem. | Great noise, and great vapour. |
| 4 | 8 30 | 145 | 0 1 | Idem. | The evaporation terminates without ebullition. |

In this experiment, the evaporation was very slow, and the electricity, which was always very feeble, was thrice negative, and thrice nothing during the interval of 5 minutes and 6 seconds at the time of the greatest heat. In a second experiment with the same crucible, the evaporation lasted 6 minutes and 15 seconds, and the electricity was also negative at the first projection, but it became positive at the second projection, and vanished at the third. In a third experiment, the electricity was stronger, and was at first negative, when the balls of the electrometer separated 3 lines. It then was positive, and the balls separated 6 parts of a line, and at the third projection it was still positive, and the separation of the balls was so much as 6 lines. Saussure now employed a cup of White Porcelain, and surrounding it with sand in a clay crucible, and having brought it to a white heat, he kept it in the clay pot during the experiments.

| Table V. Showing the Electricity produced by the Evaporation of Water placed on a heated Crucible of white Porcelain. |
|---|---|---|---|---|---|
| Number of Projections | Time of the Projection | Duration of the Evaporation | Degree of Electricity | Character of the Electricity | General Observations |
| | Min. Sec. | Seconds | Lines. Tenths | | |
| 1 | 0 0 | 0 | 0 6 | Negative. | The cup reddish, with little noise. |
| 2 | 0 20 | 5 | 0 7 | Idem. | Boiling, and vapour visible. |
| 3 | 0 40 | 7 | 0 8 | Idem. | Idem. |
| 4 | 1 0 | 7 | 0 5 | Idem. | Idem. |
| 5 | 1 30 | 9 | 0 2 | Idem. | The cup ceases to be red. |
| 6 | 2 0 | 9 | 0 2 | Idem. | Constant boiling, and vapour. |
| 7 | 2 30 | 14 | 0 2 | Idem. | Idem. |
| 8 | 3 0 | 25 | 0 4 | Idem. | The cup cracks. |
| 9 | 3 30 | 35 | 0 0 | Idem. | The vapour came out of the sand. |

The rapidity of evaporation in the porcelain crucible is very remarkable. Saussure repeated the experiments twice with different porcelain crucibles, and obtained the very same results, both with regard to the evaporation, and to the degree and kind of the electricity which was produced.

Saussure made his next experiments with Alcohol instead of water. The following results were obtained with the silver crucible formerly used, and with the same quantity, viz. 5 1/2 grains of distilled water.
### TABLE VI. Showing the Electricity produced by the Evaporation of Alcohol placed on a heated Crucible of pure Silver.

<table>
<thead>
<tr>
<th>Number of Projections</th>
<th>Time of the Projection</th>
<th>Duration of the Evaporation</th>
<th>Degree of Electricity</th>
<th>Character of the Electricity</th>
<th>General Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Min. Sec.</td>
<td>Seconds.</td>
<td>Lines. Tenths.</td>
<td></td>
<td>Crucible red, almost white; the spirit boils, then flames, and leaves a drop which turns quickly round without burning.</td>
</tr>
<tr>
<td>2</td>
<td>2 0</td>
<td>119</td>
<td>0 0</td>
<td>Negative.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4 10</td>
<td>130</td>
<td>0 2</td>
<td>Idem.</td>
<td>Boils, flames, and leaves a similar drop.</td>
</tr>
<tr>
<td>4</td>
<td>6 30</td>
<td>155</td>
<td>0 5</td>
<td>Idem.</td>
<td>Bubbles without flaming, the crucible almost without colour.</td>
</tr>
<tr>
<td>5</td>
<td>9 30</td>
<td>120</td>
<td>0 7</td>
<td>Idem.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>12 0</td>
<td>137</td>
<td>0 5</td>
<td>Idem.</td>
<td>Idem. No vapour visible</td>
</tr>
<tr>
<td>7</td>
<td>14 30</td>
<td>58</td>
<td>1 0</td>
<td>Idem.</td>
<td>Idem. Noise at the end.</td>
</tr>
<tr>
<td>8</td>
<td>16 30</td>
<td>30</td>
<td>0 8</td>
<td>Idem.</td>
<td>Great noise and great vapour.</td>
</tr>
<tr>
<td>9</td>
<td>17 30</td>
<td>21</td>
<td>0 4</td>
<td>Idem.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>18 30</td>
<td>12</td>
<td>0 0</td>
<td>Idem.</td>
<td>Evaporation finishes without boiling.</td>
</tr>
<tr>
<td>11</td>
<td>19 5</td>
<td>200</td>
<td>0 0</td>
<td>Idem.</td>
<td></td>
</tr>
</tbody>
</table>

The interesting results given in the preceding Table, induced Saussure to try a still more volatile fluid, and he obtained the following results by means of Ether, projected in measures of 5½ grains into the same crucible of pure silver, which was placed in a clay pot and surrounded with sand, in order to preserve its heat.

### TABLE VII. Showing the Electricity produced by the Evaporation of Ether placed on a heated Crucible of pure Silver.

<table>
<thead>
<tr>
<th>Number of Projections</th>
<th>Time of the Projection</th>
<th>Duration of the Evaporation</th>
<th>Degree of Electricity</th>
<th>Character of the Electricity</th>
<th>General Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Min. Sec.</td>
<td>Seconds.</td>
<td>Lines. Tenths.</td>
<td></td>
<td>Crucible red, almost white; the ether flames and leaves a drop which burns without turning.</td>
</tr>
<tr>
<td>2</td>
<td>1 30</td>
<td>37</td>
<td>0 0</td>
<td>Negative.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2 55</td>
<td>57</td>
<td>0 0</td>
<td>Idem.</td>
<td>The ether flames, and the remaining drop burns to the end.</td>
</tr>
<tr>
<td>4</td>
<td>4 15</td>
<td>57</td>
<td>0 0</td>
<td>Idem.</td>
<td>The ether flames, and the drop does not burn.</td>
</tr>
<tr>
<td>5</td>
<td>5 55</td>
<td>58</td>
<td>0 0</td>
<td>Idem.</td>
<td>The crucible no longer red; the ether flames, but not the remaining drop.</td>
</tr>
<tr>
<td>6</td>
<td>7 25</td>
<td>61</td>
<td>0 0</td>
<td>Idem.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>9 25</td>
<td>58</td>
<td>0 0</td>
<td>Idem.</td>
<td>Boils without burning during 20&quot;, then flames and leaves a drop, which burns without turning.</td>
</tr>
<tr>
<td>8</td>
<td>10 40</td>
<td>55</td>
<td>0 0</td>
<td>Idem.</td>
<td>Boils, then flames.</td>
</tr>
<tr>
<td>9</td>
<td>12 5</td>
<td>57</td>
<td>0 1</td>
<td>Idem.</td>
<td>The same as in the 6th Projection.</td>
</tr>
<tr>
<td>10</td>
<td>19 46</td>
<td>55</td>
<td>0 2</td>
<td>Idem.</td>
<td>Idem. The electricity precedes the inflammation, which destroys it.</td>
</tr>
<tr>
<td>11</td>
<td>15 15</td>
<td>57</td>
<td>0 4</td>
<td>Idem.</td>
<td>Flames at the end of 19&quot;, and remains the same.</td>
</tr>
<tr>
<td>12</td>
<td>16 45</td>
<td>62</td>
<td>0 8</td>
<td>Idem.</td>
<td>Small noise and bubbling without inflammation.</td>
</tr>
<tr>
<td>13</td>
<td>18 32</td>
<td>57</td>
<td>0 7</td>
<td>Idem.</td>
<td>A little more noise.</td>
</tr>
<tr>
<td>14</td>
<td>19 45.4</td>
<td>51</td>
<td>0 6</td>
<td>Idem.</td>
<td>Silence at first, noise at the end, and then electricity.</td>
</tr>
<tr>
<td>15</td>
<td>21 55</td>
<td>42</td>
<td>0 5</td>
<td>Idem.</td>
<td>Idem. The noise greater.</td>
</tr>
<tr>
<td>16</td>
<td>23 5</td>
<td>33</td>
<td>0 4</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>17</td>
<td>24 20</td>
<td>21</td>
<td>0 6</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>18</td>
<td>25 15</td>
<td>11</td>
<td>0 5</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>19</td>
<td>26 5</td>
<td>8</td>
<td>0 3</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>20</td>
<td>27 0</td>
<td>7</td>
<td>0 2</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>21</td>
<td>27 55</td>
<td>34</td>
<td>0 1</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>22</td>
<td>28 25</td>
<td>30</td>
<td>0 0</td>
<td>Idem.</td>
<td>Ebulition and noise during 5&quot;, and remains silent.</td>
</tr>
<tr>
<td>23</td>
<td>29 55</td>
<td>22</td>
<td>0 0</td>
<td>Idem.</td>
<td>Idem.</td>
</tr>
<tr>
<td>24</td>
<td>32 0</td>
<td>85</td>
<td>0 0</td>
<td>Idem.</td>
<td>Ebulition and noise during 15&quot;, and then remains silent.</td>
</tr>
</tbody>
</table>
ELECTRICITY.

Sauvage was greatly surprised at observing two such inflammable fluids as alcohol and ether following the same laws in their evaporation as water. The evaporation was always greater at the time of the strongest heat, than when the heat was weakest. It then diminished to a certain point, and afterwards augmented till the heat was feeblest. In the ether too, the combustion had no sensible influence on the rapidity of the evaporation.

Sauvage now wished to observe the phenomena of evaporation in a crucible almost wholly shut. He therefore took a grenade 8 inches in diameter, and brought to a white heat, and injected into it distilled water. A jet of brilliant flame was emitted from the mouth of the grenade. A similar effect was produced at the following projections, till the heated grenade had the colour of a cherry; but the brilliancy and heat of the flame diminished gradually with the heat. Sauvage supposes that the flame arose from the inflammable air, produced by the decomposition of the water, or by that of the iron. Whenever there was any flame, there was no appearance of electricity; but as soon as the flame ceased, the electricity appeared. The electricity was always positive at the first experiment, but in the second it appeared at first negative, and then nothing, when the small measure of water was projected into the grenade; but when half an ounce of water was thrown into it, the electricity was positive.

In order to explain the preceding experiments, M. Sauvage supposed that the electricity is positive with those bodies that are capable of decomposing water, or of being themselves decomposed by their contact with the water, and that it is negative with those which are not decomposed or altered. This supposition was suggested by the fact that china and silver always produced negative electricity, while iron and copper gave positive electricity. If substances capable of being oxidized, had constantly given a positive electricity, while those which do not oxidize had given a negative electricity, the preceding supposition would have acquired a great degree of probability; but the phenomena have not always followed this law, a negative electricity being sometimes produced by the iron and the copper, and a positive electricity by the silver. Sauvage remarks, that he was not much embarrassed by the first of these facts, for the iron and the copper are oxidated with great facility in a brisk fire, and become covered with a scaly crust, which, with the same degree of heat, is not susceptible of farther alteration. If this crust should therefore cover the bottom of the crucible, the drop of water will no longer be in contact with an oxidable substance, and therefore no further decomposition will take place, and consequently no farther generation of electricity. A part of the natural electricity, however, of the apparatus, will be absorbed by the vapours which are still formed, and therefore the apparatus will be electrified negatively. If, by any accident, some of the scales should be so far detached that the fluid will touch some parts of the metal, it may happen that the quantity of electricity thus generated compensates exactly for that which the vapours absorb, and consequently, the electricity will be nothing. If the scales are still more detached, the electricity will be superabundant, and consequently positive. If the same reason a larger quantity of water gives constantly a positive electricity, when it is poured into an iron or copper crucible, because it attacks the metal in a greater number of parts, and finds more easily the parts accessible to its action. Hence, also, a strong positive electricity is produced when a mass of red hot iron is thrown into water, for the points of contact being more numerous, a more abundant decomposition takes place.

Sauvage found it more difficult to explain why silver sometimes gives a positive electricity. He conjectured, however, that it arose from foreign bodies, such as copper or other oxidizable metals being mixed with the silver. This conjecture originated in his observing, that though the crucible was extremely clean, and the distilled water very pure, yet when the water was reduced to a drop, by evaporation, the drop always appeared blackest, and left a brown or black globule after the evaporation was completed.

In order to verify this explanation, he boiled spirit of salt in his silver crucible, and after having washed it with much care, he found that the electricity which it produced was always negative, even when he projected half an ounce of water into the crucible.

He also observed, that when quartz, brought to a white heat, was plunged in water, positive electricity was produced; a result which he ascribes to a small quantity of iron which may have existed in the quartz.

The production of negative electricity by burning charcoal greatly perplexed our author. In his first experiments he found the electricity to be positive, but observing that Volta had found it to be negative, he discovered the cause of his mistake, and afterwards obtained the same results as those of Volta. He supposes that it may arise from the readiness with which that substance loses its heat in contact with water.

Sauvage endeavoured to obtain electricity from combustion, but his attempts were fruitless, although Volta had obtained distinct indications of it in similar cases. He burned different bodies upon an insulated chafing-dish, sometimes with a clear, and sometimes with a smoking flame; and he endeavoured suddenly to explode small heaps of gunpowder, but no electricity whatever appeared.

His attempts to procure electricity without ebullition were equally fruitless. He exposed great surfaces, such as six square feet of wet linen, before a large fire, and insulated it by silk cords. When the linen was strongly heated, a greater quantity of vapour was produced than in a coffee-pot boiling on a chafing-dish, and though he used the most delicate electrometer, yet no electricity could be seen. He likewise spread out on the moist ground a large plate of white iron, and heated it strongly on a chafing-dish, but though the earth exhaled a great quantity of vapour, no electricity was produced. See La Place and Lavoisier, Mem. Acad. Par. 1781, p. 292; Volta, Journal de Physique, 1783; and Sauvage, Voyages dans les Alpes, 8vo, 1786, tom. iii. p. 316—347.

SECT. IV. On Electricity produced by a separation of Parts.

One of the most singular electrical phenomena which belongs to the present Section, is the evolution of electrical light by the bursting of the unannealed glass teardrop, called Prince Rupert's drops; a fact which was discovered by Dr Brewster. These drops, which he found to possess the property of transpolarizing light, were regularly crystallised, and had three different cleavages: one like that of a melon, diverging from the apex of the drop; another concentric with the surface of the drop; and a third oblique to the axis. Having laid one of these drops upon a table in a dark room, and covered it with a plate of thick glass, to prevent any of the electrical light from the bursting of unannealed glass drops.
ELECTRICITY.

Fragments from reaching the eye, the drop was burst by breaking off a part of its tail, and the whole of it appeared luminous; so that at the instant of the fracture, a quantity of light, of the same shape and size as the drop itself, was distinctly visible. The drop which gave this singular result was made of flint glass, and was the largest that he had ever seen. Every other flint glass drop produced a distinct electrical light; but in none of them, except the large one, could he see the luminous shape of the drop. The same light appeared when they were burst under water.

The small glass drops made of bottle glass never exhibited any light at the moment of bursting; but it was almost always visible in small sparks, in bottle glass drops of a larger size.

A similar phenomenon is exhibited in Muscovy tale, when its lamina are suddenly torn asunder. Electricity is immediately developed, and a bright flash of light is exhibited.

Mr. William Wilson found, that if a piece of dry and warm wood is suddenly split asunder, the two contiguous surfaces are electrified, the one positively and the other negatively.

When a stick of sealing wax is broken in two, the two fractured extremities are distinctly electrified, the one end positively, and the other negatively.

Connected in some measure with the preceding results, are those which were obtained by Mr Wilson respecting the electricity of wood shavings. Having had frequent occasion to work very dry wood that had lain for several hours over a large fire, Mr Wilson often observed the shavings adhering to the tools, and to every thing that they touched. He therefore instituted a set of experiments, for the purpose of ascertaining the origin of the electricity, and obtained the following general results. When dry wood was scraped with a piece of window glass, the shavings always exhibited positive electricity. When the wood was chipped with a knife, the electricity of the chips was positive when the wood was hot, and the edges of the knife not very sharp, but negative when the wood was perfectly cold. When the edge of the knife was very sharp, the chips were negatively electrified whatever was the temperature of the wood. Having insulated a penknife, by fixing it into a glass tube covered with sealing wax, he found that it always possessed an electricity contrary to that of the chips, which were most frequently positive. The surface of the wood from which the chips were detached was seldom electrified, and when it was, the electricity was always very weak, and of the same denomination as that of the weakest of the other two. See Thomson's Annals of Philosophy, vol. iv. p. 448. Nicholson's Journal, 8vo, vol. iv. p. 49—53.

Sect. V. On the Electricity produced by dropping Powders on a Metallic Plate.

Mr Cavallo and Mr Bennet have shewn, from numerous experiments, that when electrics or conductors are reduced to powder, the powders may be rendered electrical, merely by dropping them on an insulated plate.

Mr Cavallo insulated a metallic plate upon a glass stand, and connected it with a cork ball electrometer. He held the powder to be tried in a spoon, about one inch above the plate, and allowed it to fall gradually. The electricity acquired by the powder was thus communicated to the plate, and thence conveyed to the electrometer. When the powder of a conducting substance was used, it was placed in some electric substance, such as a glass phial, or a plate of sealing wax.

In making such experiments, it is necessary to have the powders dry and warm as possible, otherwise no signs of electricity will be observed. With these precautions, Mr Cavallo obtained the following results. Powdered resin let fall from a metal spoon, glass, or paper, communicates a strong negative electricity to the plate; and when the spoon, or body which held the powder, was insulated, it was strongly positive. Flowers of sulphur electrified the plate negatively, but not so strongly. Powdered glass, dropped from a warm and dry piece of paper, communicated a negative electricity to the plate, but it was weaker than that of the resin. When it was dropped from a brass cup, the electricity was very weak but positive. Steel filings, dropped either from paper or from a glass phial, electrified the plate negatively; but brass filings, let fall under the same circumstances, electrified it positively. Gunpowder, very fine emery, and the amalgam of tin-foil and mercury, when dropped from a glass phial, electrified the plate negatively; whereas mercury itself, let fall from a glass phial, electrified the plate positively. Soot, and the ashes of pitchcoal mixed with small cinders, when dropped from a piece of paper, electrified the plate negatively.

Mr Bennet found, that powdered chalk falling from one plate to another placed upon his electrometer, electrified it negatively; and the same effect was produced by red ochre, yellow resin, coal ashes, powdered crocus metallosum, aurum mosaicum, black lead, powdered quicklime, amber, lapis calaminaris, Spanish brown, powdered sulphur, flowers of sulphur, iron filings, rust of iron, and sand.

The most accurate experiments, however, which have been made upon this subject, we owe to Mr Singers, who employed two methods of bringing the bodies into contact: 1st, By sifting the powders on the cap of a delicate electrometer through a fine sieve, which was immediately cleaned after every experiment; and 2dly, By bringing an insulated copper plate repeatedly in contact with the powders, spread out into an extensive surface on a dry sheet of paper. By the first of these methods he obtained the following results.

Negative electricity was produced by the following bodies, when sifted on the cap of an electrometer.

Copper,
Iron,
Zinc,
Tin,
Bismuth,
Antimony,
Nickel,
Black lead,
Lime,
Magnesia,
Barytes,
Strontites,
Alumine,
Silex,
Brown oxide of copper,
White oxide of arsenic,
Red oxide of lead,
Litharge,
White lead,
Red oxide of iron,
Acetate of copper,

Sulphate of copper,
Sulphate of soda,
Phosphatic of soda,
Carbonate of soda,
Carbonate of ammonia,
Carbonate of potash,
Carbonate of lime,
Muriate of ammonia,
Common pearl ashes,
Boracic acid,
Benzolic acid,
Oxalic acid,
Citic acid,
Tartaric acid,
Cream of tartar,
Oxymuriate of potash,
Purp. vitri.of mag.,
Sulphur,
Sulphuret of lime,
Starch,
Oxypotash.
Positive electricity was produced by the following bodies when sifted on the cap of the electrometer.

- Wheat flour,
- Oatmeal,
- Lycopodium,
- Quassia,
- Powdered cardamom,
- Charcoal of wood,
- Sulphate of potash,
- Nitrate of potash,
- Acetate of lead,
- Oxide of tin.

When the bodies in the two preceding Tables were sifted either through a sieve of hair, flannel, or muslin, the same kind of electricity was always produced.

In applying the second method, Mr. Singers broke the pure alkali into small pieces, and exposed them in an open phial, for a quarter of an hour, to a moderate heat, which was not great enough to fuse the alkali. It was then quickly reduced to powder in a warm and dry mortar, and instantly distributed over a dry sheet of card paper, which, during a certain time, he found to attract the moisture from the alkali, as fast as the alkali attracted it from the air. In this way he obtained the following results, the copper plate being always electrified in an opposite manner to that of the powders.

**Positive Electricity.**

- Lime,
- Barytes,
- Strontites,
- Magnesia,
- Pure soda,
- Pure potash,
- Common pearl ashes,
- Carbonate of potash,
- Carbonate of soda,
- Tartaric acid.

**Negative Electricity.**

- Benzoic acid,
- Boracic acid,
- Oxalic acid,
- Citric acid,
- Silesia,
- Alumine,
- Carbonate of ammonia,
- Sulphur,
- Rosin.

From the circumstance of sulphur and rosin giving the same kind of electricity when touched with a copper plate, as that which is produced by friction, Mr. Singers supposes, that the contact of dissimilar bodies is in general the primary source of electrical excitation.


**Sect. VI. On the Electricity produced in the Electric Column discovered by De Luc.**

As the electricity generated in the electric column has no appearance of being produced by chemical action, the consideration of it belongs more properly to electricity than to galvanism.

The electric column invented by that ingenious philosopher, J. A. De Luc, consists of several hundred small discs of zinc and gilt paper placed upon each other alternately, and inclosed in a glass tube. When the number of discs amounts to 800 or 1000, the apparatus will, at any time, produce a perceptible effect upon the electrometer without any preparation. The electric column is represented in Plate CXCIV. Fig. 8. The column is represented at AB, supported horizontally on two rods 1, 1, made of solid glass, coated with sealing wax or any other insulating varnish, and fixed by female screws on the wooden bar 2, 2. It consists of 600 groups formed of plates of zinc, seven tenths of an inch in diameter, and equal pieces of plain gilt Dutch paper (which is paper covered with copper,) the upper side of which being turned towards A, thus becomes the positive extremity of the column; and since the paper seems only to separate the binary groups of zinc and copper, the latter being in each of them on the side of B, this becomes the negative extremity of the column. The groups of zinc and Dutch gilt paper are contained between three glass rods, coated with sealing wax, and fixed in holes of the brass plates A, B, where they must be inserted while the plates are hot, and the holes filled with sealing wax. In the lower part of these brass plates is a pin, which enters freely into the brass cap at the top of the pillars 1, 1. Two screws 3, 3, formed on the outside in the shape of loops, pass through the brass plates A, B, and serve both to press the groups against the glass rods, and to form a communication between the extremities of the column and the electrometers M, N, as represented in the Figure. In order to determine the electric state of different parts of the column, a third electrometer P is used. It is shown in the Figure as connected with the centre of the column by a loop upon a thick brass plate, but when it is required to examine the state of other parts of the column, it may be removed to communicate with any point of it by the insertion of a soft wire held in the middle by an insulating handle. For some experiments, brass hooks 5 and 6 are fixed to the brass plates A, B, and project about an inch; and in experiments on the conducting faculty of glass tubes filled with water, the tube TU may be hung at the point of a hook upon the wire suspended by silk threads 7, 10, 11 passing over the pulley 10, and descending to a thin brass plate 11 fixed at the base of the instrument. The other wire 9 of the tube is hooked to the projecting wire 6.

In order to accommodate the instrument for exhibiting the electrical state of the atmosphere, De Luc fixed at the top of one of the pillars of the column at its positive extremity, a brass piece 13 held by a female screw, and projecting forwards about 1½ inch. On this projection is fixed, by means of a screw, another brass piece, having on one side a vertical groove 14. A brass rod is held in this by a pin, and at the lower end of the rod is a brass ball 15, which can be brought backwards and forwards. From the top of the rod projects a brass loop 16, to which is suspended by the finest silver wire a gold ball 17. The ball is fixed at one extremity of a piece of brass 18, lying on two insulating pillars 27, 27, upon the lead bars 19, 19. A brass spring 23, movable backwards and forwards upon pins 20, 20, about half an inch in breadth, at the base 24, is fixed into the piece 24, where it passes under the bent part of an upright brass piece 25. The breadth of the spring 23 diminishes towards its end, where it is terminated by a brass bow 22, across which is stretched a fine silver wire 21. At the top of the upright brass piece 25, is a screw 26, which presses the spring 23 for the purpose of giving a small motion of adjustment to the wire 21.

When the instrument is thus constructed, the leaves of the electrometer M will diverge with positive, and those in N with negative electricity; but when the finger is laid on either of them, in order to produce a communication with the ground, the divergence will cease in that electrometer, and become nearly double in the other. When the finger is removed, and the column left, to its own operation, the divergencies are not restored to their former state, half an hour or an hour being necessary to reproduce them. If an insulated body, however, electrified either positively or negatively,
so as merely to affect the gold leaf electrometer, is applied to one extremity when the column is in this state, the effect will be instantly perceived at the other end. In order to restore quickly the state of the divergencies, the fingers should be laid on both extremities of the column together, and then removed at the same instant, when the original state of divergency will be restored. By means of the third electrometer P, De Luc has shown that the negative effect goes on increasing from the zinc to the copper end of the column, while the positive effect increases from the copper to the zinc extremity, so that the electric state of each intermediate point is the sum of the corresponding terms of two inverse progressions represented by determined, though, in some respects, variable numbers. When the divergencies at both extremities are equal, there is no divergency at C, which is in a neutral state. When a communication is made with the ground at B, the electrometer at C diverges with positive electricity in the same degree as it did before at A, and the divergence of A is now nearly double. It is now found that the whole column is in a positive state increasing towards A, excepting the very extremity B, which is neutral from communicating with the ground. When the communication with the ground is made at A, the electric states of the column are all reversed. The electrometer C being now negative, and equal to that at B in the insulated state of the column, the negative state increases towards B, A being neutral. When the glass tube TU is filled with water, suspended as in the Figure, the column being insulated, the electrometers continue in the state of equal divergence; but when the hook of the wire 8 is disengaged from the silk thread, and fixed to the hook 5, the circulation of the electric fluid through the glass tube is so rapid, that the divergencies in the electrometers entirely cease, and return only when the extremity of the wire 8 is again lifted up. In this way De Luc tried the conducting powers of various bodies, which are reduced to slips or rods, and laid on the hooks 5, 6. The rods are first laid upon two brass wire brackets 12, 12, fixed on the front of the instrument, and they are taken up by two glass hooks covered with sealing wax, in order that they may be placed on the hooks 5, 6, without disturbing the electrical state of the column. As these substances have more or less a conducting quality, they diminish in different degrees the divergence of the electrometer, by transmitting more or less of the electric fluid from A to B. In this way De Luc made a very curious experiment. A thin slip of deal cut along the fibres was applied to the column, and almost no divergence remained in the electrometer, while another slip of the same wood, and of the same thickness and breadth, but cut across, produced much less diminution in the divergence.

De Luc has likewise applied his column to the purpose of determining the insulating qualities of bodies. These bodies should be placed upon the brackets 12, 12, and after being allowed to remain there a little time, they should be breathed upon, in order that the moisture of the breath may dissipate any electricity they contain, and conduct it to the ground. As soon as the moisture is evaporated, the body must be taken up with insulated hooks, and then applied to the column upon the hooks 5, 6. A naked glass rod, placed in this way upon the hooks, sensibly diminishes, in a short time, the divergence of the electrometer. In this way De Luc found that sealing-wax was the best electrical varnish, but that the finest kind was not the most perfect insulator.

In converting this instrument into an aerial electroscope, as De Luc calls it, for observing the electrical changes which take place in our atmosphere, he employed the apparatus connected with the gold ball 17, which we have already described. When the ball 17 was suspended without the apparatus at 21, 22, it often stuck to the large ball 18; but when the horizontal silver wire 21 is so adjusted to the position of the suspending wire 16, 17, that the two meet, the very instant before the ball 17 strikes the ball 18, the sudden jerk which is thus produced effectually prevents the sticking of the ball. As the strikings of the ball 17 are disturbed by the least shaking motion, De Luc found it necessary to place the instrument in a glazed box, and his apparatus was then ready for use. The following observations made on the 10th of May, will show the nature of the observations which our ingenious author made with his electroscope, after having placed some additional columns for the purpose of increasing its power.

<table>
<thead>
<tr>
<th>May 10th, 8 A.M.</th>
<th>Barometer</th>
<th>Thermometer</th>
<th>Hygrometer</th>
<th>Number of Strikings in 5'</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.15</td>
<td>63°</td>
<td>40</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>30.15</td>
<td>67</td>
<td>40</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>30.17</td>
<td>67</td>
<td>40</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>30.20</td>
<td>66</td>
<td>40</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>30.25</td>
<td>65</td>
<td>40</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>30.25</td>
<td>65</td>
<td>40</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

The strikings of the balls having ceased on the 14th of May, and on other subsequent days, De Luc was induced to think of connecting the ball 18 with the negative extremity of the columns, in order to observe if the strikings would thus be more numerous; and it occurred to him, at the same time, that, by quickly changing the connection of the ball for that with the ground, and inversely, he would be enabled to discover variations in the electric state of the ground, by comparing, in a short time, its effect on the strikings with that of the negative extremity of the columns. This he accomplished by means of the insulating pillars 27, 27, and by changing the position of the brass wire 29, he was enabled, in a moment, to form a communication either with the ground, or with the negative end of the columns. The following observations, made on the 20th, 27th, and 28th of May, will show the kind of information which the column affords, when the ball is connected with the ground, or with the negative extremity of the columns.
When M. De Luc was engaged in these experiments, Mr. B. M. Forster succeeded in producing a constant electrical column, by making the action of the column set in motion a brass ball, suspended by a silk thread between two small insulated bells, connected with the two extremities of a column, consisting of 1500 groups of the same diameter as those used by De Luc. The apparatus of the bells is represented in Plate CCXLV. Fig. 9, where A, B are the two bells, supported on glass pillars, and c the small brass ball which acts as a clapper in ringing the bells. On the 14th of March 1810, Mr. Forster put this apparatus into a closet, and connected it with the three columns AB, CD, EF, represented in Fig. 10. The bells immediately began to ring, and continued till the 24th March, when the ringing ceased about a minute. This ringing continued without ceasing till the 4th of September, when it ceased about 10 minutes. They began again to ring at intervals, stopping, perhaps, half a second or more at a time. After this they stopped for several days, and at other times for hours, and on the 18th of November Mr. Forster removed them from the column.

Mr. Forster made also a number of experiments with the electric column. He found, that the electricity of the column acted through a portion of air; and he communicated a slight charge to a coated jar.

Mr. Singers, to whom electricity is under great obligations, constructed an apparatus with the electric column, which never ceased to ring for 14 months, except during its removal from one place to another. During an interval of 6 months, when it was not disturbed, there was no interruption in the ringing. M. De Luc has a pendulum, which has vibrated between two balls for more than two years, and still continues.

In Plate CCXLV, we have shewn the different ways in which the electric column is fitted up for different purposes. The figures are taken from Mr. Singers' Elements of Electricity. Fig. 11 represents a column of 1000 series, lying horizontally upon the caps of two delicate gold leaf electrometers. Fig. 12, represents the apparatus for ringing, which consists of two vertical columns inclosed in a glass receiver, having a bell fixed at the lower extremity of each, and having suspended between them, by a very fine thread of raw silk, a brass ball. Fig. 13 represents De Luc's aerial electroscope, which consists of a vertical column insulated and enclosed in a glass receiver. The column consists of one to two thousand series. A bent wire having a ball a at its lower end, is connected with the upper extremity of the column, so as to hang parallel to the column, and at some distance from it. Opposite to this ball a is a similar ball b, screwed into the lower cap of the column, and into the same cap is screwed a brass fork f, with a fine silver wire stretched between its prongs, for the purpose of preventing the little ball from sticking, as formerly described. The pendulum d consists of a fine silver wire d, suspending a gilt pith ball, which would always be in contact with the brass ball b if influenced only by gravity.

M. De Luc has recently observed, that the power of electric columns, (as pointed out by the oscillation of a pendulum,) is increased by the action of the sun's rays; and this remark has recently been confirmed by Mr. Hausmann. M. De Luc imagined, that this effect was not produced by the heat of the sun; for he remarked, that a column composed of paper discs thoroughly dried had very little power. Mr. Singers, however, has found that the power of the bell-ringing apparatus is increased by a moderate heat. It always pulsates most slowly in winter; and whenever a fire was made in the room, the ringing became more rapid. When the temperature of his apartment was 50°, Mr. Singers applied a column of 1000 series to the cap of a gold leaf electrometer, and he found that the gold leaf struck the sides of the glass nine times in 60 seconds. He then placed the columns during 10 minutes before a fire, so that the electrometer rose to 85°. When the column was now applied to the electrometer, the gold leaves struck the side 37 times in 60 seconds. When it was removed to another part of the room, so as to recover its original temperature of 50°, the gold leaves struck only nine times in 60 seconds as before.

As the following observations on the electric column are both new and ingenious, we shall make no apology for presenting them in Mr. Singers' own words. "There appears every reason to believe, that the action of a well constructed column will be permanent. I have several that have been constructed nearly three years, and they are still as active as at first. There is, however, a precaution necessary to their constant and immediate action. The two ends of a column should never be connected by a conducting substance for any length of time; for if, after such continued communication, it be applied to an electrometer, it will scarcely affect it for some time. It is therefore necessary when a column is laid by, that it be placed upon two sticks of sealing-wax, so as to keep its brass caps at the distance of about half an inch from the table, or other conducting surface on which it is laid; and if a column, which appears to have lost its action by lying by, be insulated in this way for a few days, it will usually recover its full power.

There is another cause of deterioration which is more fatal; it is the presence of too much moisture. If the paper be perfectly dry, it is a non-conductor, and will not therefore produce any action in the column. But this perfect dryness can only be obtained, by exposing the paper to a heat nearly sufficient to scorch it; and in its slightest natural state I have always found the paper sufficiently a conductor, even when, by exposing the paper discs to the heat of the sun, they have been so dried as to warp considerably. When the paper is sufficiently dry, the action of the column continues without diminution;
ELECTRICITY.

The remarkable property of this fish to produce a sensation of numbness on those who touch it, was known to Aristotle and Pliny, who considered it as a mode of defence against fish of a large size, and as a method of catching the smaller fish, upon which it subsisted. Oppian informs us, that the torpedo, when caught by the hook, exerts itself in such a manner, that its influence passing along the line benumbs and stupefies the fisherman.

Among modern naturalists, it appears to have been first observed in the year 1676 by Liedi, who relates, that it was a prevailing opinion among the fishermen, that the shock of the torpedo was communicated to the hand and arm of the person catching the fish, by means of the line and rod to which it was suspended. A few years afterwards, the anatomy of this animal was examined by Lorenzini, who published engravings of its electrical organs. From this benumbing faculty, the fish received the name of Torpedo; and while the philosophers of Europe were perplexing themselves about the cause of this extraordinary property, the Arabians had identified its action with that of atmospheric electricity, by giving it the name of _faraç_, or _rasch_, which in their language signifies lightning.

Reaumur seems to have been the first philosopher, who examined with any thing like accuracy the properties of the torpedo; but he committed a great mistake in ascribing them to the force of its muscles. He observed, that when the torpedo wished to exercise its electrical organs, it first sensibly diminished the curve on its back, till the surface became flat, or even concave, and then by a sudden motion it raised it again to its former convexity. If the fish in this state was
touched by the finger, a sensation resembling numbness was immediately experienced.

Kempler, in his *Annales Exotica*, published in 1702, has given a good description of the effects of the torpedo; and without imagining them to be similar to those of electricity, he compares them to the effects of lightning. He states, however, that the benumbing influence could be evaded if the person held in his breath, a circumstance which Mr. Walsh afterwards found to be correct.

Dr. Bancroft was the first philosopher who suspected, that an analogy existed between the effects of the torpedo and those of electricity, and he has mentioned this supposition in his Natural History of Guiana. Mr. Walsh, however, had the merit of ascertaining this important point; and in his valuable paper on the torpedo, he has made us acquainted with the leading properties of that singular animal. In order to verify the suspected resemblance between the torpedo and the Leyden phial, Mr. Walsh placed a live torpedo upon a table covered with a wet napkin, around which stood five persons insulated. Two brass wires, each 13 feet in length, were suspended to the ceiling by silken strings. The extremity of one of them was placed on the wet napkin, while its other extremity was immersed in a basin full of water placed on a second table, on which stood four other basins full of water. The first person plunged a finger of one hand in the basin in which the wire communicating with the wet napkin was immersed, and a finger of the other hand into the second basin. The second person put a finger of one hand in this last basin, and a finger of the other hand into the third basin; and so on in succession, till the five persons communicated with one another by the wires in the basons. The extremity of the second wire was immersed in the last basin of all; and Mr. Walsh having taken the other end of this wire in his hand, touched the back of the torpedo, when all the five persons experienced a commotion, which differed only in force from that produced by the Leyden phial: Mr. Walsh being out of the circuit, received no shock. This experiment was repeated frequently with the same result, even when eight persons were in the circuit. In other experiments, the shock of the torpedo was communicated through iron wires, and a great many other conductors; and it was found to be incommunicable through air, glass, and other electrices. Mr. Walsh was never able to produce an electric spark, nor to communicate any electricity to the pith balls of the electrometer.

In general, the shock of the torpedo is not sensible beyond the touching finger; and out of 200 shocks, only one extended above the elbow. When the torpedo was insulated, it was able to give 40 or 50 shocks without any diminution of force to persons likewise insulated. Every shock of the animal is attended with a depression of its eyes, by means of which Mr. Walsh observed its attempts to give them even to non-conductors.

These experiments having been made solely in air, Mr. Walsh was anxious to examine its effects in water. A large torpedo, very prolific in shocks, was held in both hands by his electric organs above and below, and was then suddenly plunged a foot under water, and instantly raised to the same height in the air. This operation was continued for a minute. The moment his lower surface touched the water in descending, he always gave a violent shock, and the moment that surface quitted the water upon its ascent, a still more violent shock was experienced. Both of these shocks, but particularly the last, were always accompanied with a writing in his body, as if he was anxious to make his escape. When the animal was wholly in the air, he almost always gave two shocks, and constantly one, and sometimes two, when he was below water. The intensity of the shock under water was scarcely one-fourth of that at the surface, and not much more than one-fourth of those given in the air. The number of shocks appeared to be about 20 in a minute.

Mr. Walsh next put the torpedo into a flat basket, open at the top, but secured by a net with wide meshes, and in this state the animal was let down about a foot into the water. When it was now touched through the meshes with only a single finger on one of its electric organs, while the other hand was held at a distance in the water, he gave shocks which were distinctly felt in both hands. When the circuit for the passage of the electricity was contracted to the finger and thumb of one hand, the finger being applied above, and the thumb below, to a single organ, a shock was experienced twice as great as that which was received when the two arms formed the circuit.

When the torpedo in the basket was raised to within three inches of the surface of the water, and was then touched with a short iron bolt held in one hand, half out and half in the water, while the other hand was dipped into the water at a distance, strong shocks passing through the iron bolt were experienced in both hands. When the communication between the bolt and the hand was made by a wet hempen cord, the shock was conveyed as before.

When a powerful torpedo was suspended in a net, and frequently dipped into water, as already described, slight shocks were communicated through the net to the persons that held it.

In order to explain the difference between the electricity of the torpedo and the Leyden phial, Mr. Walsh observes, that the same quantity of electricity will produce very different effects, according as it is used in a dense or a rare state. A small phial, with a coated surface of six square inches, will be able to force its charge through an inch of air, and exhibit attraction and repulsion, as well as the electric snap and the electric spark. But if this same quantity of electricity is diffused over two large connected jars with a coated surface, with an area 400 times larger than that of the phial, it will exhibit the effects of the torpedo. The charge in this diluted state will not pass through the hundredth part of an inch of air, it will even refuse to pass through the minute interruption in the strip of tinfoil; the spark and snap, and the approach and recession of light bodies, will no longer be produced; a point brought near will not be able to draw off the charge, and yet in this attenuated state it will run through a considerable circuit of conducting bodies, and during its passage will make us sensible of its impulse.

A number of experiments on the torpedo were made at Leghorn by Dr. Ingenhouz, in 1773. His results were nearly the same as those obtained by Mr. Walsh. He describes the shocks or tremors, as giving the same sensation as if a great number of very small electrical bottles were discharged through his hand very quickly one after another. Sometimes he found the shock very weak, and at other times it was so strong that he was nearly obliged to quit his hold of the animal. When he pinched the fish with his nails, it did not give more or fewer shocks than when it was not pinched; but by folding his body, or by bending his right side to his left side, he experienced the shocks more frequently.
The electricity of the torpedo was examined with great care in the year 1805, by Messrs Humboldt and Gay Lussac, who procured several torpedoes at Naples. The following are the principal results which were obtained by these distinguished philosophers.

1. A person much in the habit of receiving electric shocks, can support with some difficulty the shock of a vigorous torpedo 14 inches long. The action of the torpedo below water is not perceptible, till it is raised above the surface of the water.

2. Before each shock, the torpedo moves its pectoral fins in a convulsive manner, and the violence of the shock is always proportional to the extent of the surface of contact with the water.

3. The organs of the torpedo cannot be discharged by us at our pleasure, nor does it always communicate a shock when touched. It must be irritated before it gives the shock, and, in all probability, it does not keep its electric organs charged. It charges them, however, with astonishing quickness, and is thence capable of giving a long series of shocks.

4. The shock is experienced, when a single finger is applied to a single surface of the electric organs, or when the hands are placed once on the upper and one on the under surface at the same time, and in both these cases the shock is equally communicated, whether the person is insulated or not.

5. If an insulated person touches the torpedo with his finger, it must be in immediate contact, as no shock is received if the animal is touched with a key, or any other conducting body.

6. When the torpedo was placed upon a metallic plate, so that the inferior surface of its electric organ touched the metal, the hand which supported the plate felt no shock, although the animal was irritated by another insulated person, and when it was obvious, from the convulsive motions of its pectoral fins, that it was in a state of powerful action.

7. If a person, on the contrary, support with his left hand the torpedo placed on a metallic plate, and if he touches, with his right hand the upper surface of the electric organ, a violent sensation will be felt in both his arms at the same instant.

8. A similar shock will be received, if the fish is placed between two metallic plates, the edges of which do not touch, and if a person applies a hand to each plate at the same instant.

9. If, under the circumstances of the preceding experiments, there is a connection between the edges of the two plates, no shock will be experienced, as a communication is now formed between the two surfaces of the organ.

10. The organs of the torpedo do not affect the most delicate electrometer. Every method was tried in vain of communicating electricity to the condenser of Volta.

11. A circle of connection being formed, by a number of persons, between the upper and under surfaces of the organs, they received no shock till their hands were moistened in water. The shock was equally felt, when two persons, who had their right hand applied to the torpedo, instead of taking hold of each other's left hands, plunged a pointed piece of metal into a drop of water placed upon an insulating body.

12. By substituting flame in place of a drop of water, no sensation was experienced till the two pointed pieces of metal came in contact with the flame.

13. No shock will be experienced, either in air or below water, unless the body of the electric fish is immediately touched. The torpedo is unable to communicate its shock through a layer of water, however thin.

14. The least injury done to the brain of this animal prevents its electrical action.

A number of curious experiments on the torpedo were made by the Abbé Spallanzani. He observed, that when the animal was laid upon a plate of glass, the shock was then the strongest. "In irritating the back of the torpedo," he remarks, "I always obtained the shock whether it was out of the water or in it. If, instead of irritating the back, I gently irritated the breast, I also received a shock, but not so frequently as in irritating the back. If I irritated the back with one hand, and the breast with another, the hand which touched the back received the shock but not the other. But when I irritated the back with two fingers of one hand, and the breast with four fingers of the other, then I received the shock from the breast, and obtained all these results whether I was insulated or not." M. Spallanzani observed, that some minutes before the torpedo expired, the shocks were not given at intervals, as in the healthy state of the animal, but were changed into a continual battery of small shocks; and he compares the sensation to that which would be produced by laying the fingers upon a heart in a state of pulsation. The battery continued seven minutes, and during this short space of time his fingers experienced 316 shocks; the shocks then suffered an interruption, and the animal, immediately before it died, gave a few very languid shocks. We are indebted to Spallanzani for the knowledge of a still more curious fact. He found, that even the fuses of a torpedo, when in the womb of the mother, possess the same electrical property as after they are born. Having dissected a female torpedo, when she was about to expire, he saw in the ovarium eggs almost round and of different magnitudes, and on opening two vessels which shutted against the rectum, he found two perfectly formed fuses, which he detached from their envelopes, and submitted to the same experiments which he had made upon the mother. These fuses gave a perceptible shock, which was strongest when they were laid upon a plate of glass.

The common experiments on the torpedo were repeated and verified at Narbonne in the month of August 1779, by the Abbé Berthon.

At the request of Mr Walsh, the celebrated anatomist Dr Hunter examined carefully the electrical organs of a torpedo about 18 inches long and 12 broad, and about two inches thick in its thickest part. The following were the results of his examination.

"The electric organs of the torpedo are placed on each side of the cranium and gills, reaching from thence to the semicircular cartilages of each great fin, and extending longitudinally from the anterior extremity of the animal, to the transverse cartilage which divides the thorax from the abdomen; and within these limits they occupy the whole space between the skin of the upper and under surfaces; they are thickest at the edges near the centre of the fish, and become gradually thinner towards the extremities. Each electric organ, at its inner longitudinal edge, is unequally hollowed, being exactly fitted to the irregular projection of the cranium and gills. The outer longitudinal edge is a convex elliptic curve. The anterior extremity of each organ makes the section of a small circle; and the posterior extremity makes nearly a right angle with the inner edge. Each organ is attached to the surrounding parts by a close cellular membrane, and also by short and strong tendinous fibres, which pass di-
rectly across from its outer edge to the semicircular cartilages. They are covered, above and below, by the common skin of the animal, under which there is a thin fascia spread over the whole organ. This is composed of fibres, which run longitudinally, and in the direction of the body of the animal. These fibres appear to be perforated in innumerable places, which gives the fascia the appearance of being fasciculated. Its edges all around are closely connected to the skin, and at last appear to be lost, or to degenerate into the common cellular membrane of the skin. Immediately under this is another membrane exactly of the same kind; the fibres of which, in some measure, decussate those of the former, passing from the middle line of the body outwards and backwards. The inner edge of this is lost with the first described; the anterior, outer, and posterior edges, are partly attached to the semicircular cartilages, and partly lost in the common cellular membrane.

This inner fascia appears to be continued into the electric organ by so many processes, and thereby makes the membranous sides, or sheaths of the columns, which are presently to be described; and between these processes the fascia covers the end of each column, making the outermost, or first partition. Each organ of the fish under consideration is about five inches in length, and at the anterior end three in breadth, though it is but little more than half an inch broad at the posterior extremity. Each consists wholly of perpendicular columns, reaching from the upper to the under surface of the body, and varying in their length, according to the thickness of the parts of the body where they are placed; the longest column being about an inch and a half, the shortest about one-fourth of an inch in length, and their diameter about two-tenths of an inch.

The figures of the columns are very irregular, varying according to situation, and other circumstances. The greatest number of them are either irregular hexagons, or irregular pentagons; but, from the irregularity of some of them, it happens, that a pretty regular quadrangular column is sometimes formed. Those of the exterior one are either quadrangular or hexagonal; having one side external, two lateral, and either one or two internal. In the second row they are mostly pentagonal. Their costs are very thin, and seem transparent, closely connected with each other, having a kind of loose network of tendinous fibres passing transversely and obliquely between the columns, and uniting them more firmly together. These are mostly observable where the large trunks of the nerves pass. The columns are also attached by strong inelastic fibres passing directly from the one to the other.

The number of columns in different torpedos, of the size of that now offered to the Society, appeared to be about 470 in each organ; but the number varies according to the size of the fish. These columns increase, not only in size, but in number, during the growth of the animal; new ones forming perhaps every year on the exterior edges, as they are much the smallest. This process may be similar to the formation of new teeth in the human jaw, as it increases. Each column is divided by horizontal partitions placed over each other at very small distances, and forming numerous interstices, which appear to contain a fluid. These partitions consist of a very thin membrane, considerably transparent. Their edges appear to be attached to one another, and the whole is attached by a fine cellular membrane to the inside of the columns. They are not totally detached from one another. I have found them adhering at different places, by blood-vessels passing from one another.

The number of partitions contained in a column of one inch in length, of a torpedo which had been preserved in proof's spirit, appeared, on a careful examination, to be 150; and the number in a given length of column, appears to be common to all sizes in the same state of humidity; for by drying them they may be greatly altered. Whence it appears probable, that the increase in the length of a column, during the growth of the animal, does not enlarge the distance between each partition in proportion to that growth; but that new partitions are formed and added to the extremity of the column from the fascia.

The partitions are very vascular; the arteries are branches from the veins of the gills, which convey the blood that has received the influence of respiration. They pass along with the nerves to the electric organ, and enter with them; they then ramify, in every direction, into innumerable small branches on the sides of the columns, sending in from the circumference all around, on each partition, small arteries, which ramify and Anastomose on it; and passing also from one partition to another, Anastomose with the vessels of the adjacent partitions. The veins of the electric organ pass out close to the nerves, and run between the gills to the auricle of the heart.

The nerves inserted into each electric organ, arise by three very large trunks from the lateral and posterior part of the brain. The first of these, in its passage outwards, turns round a cartilage of the cranium, and sends a few branches to the first gill, and to the anterior part of the head, and then passes into the organ towards its anterior extremity. The second trunk enters the gills between the first and second openings, and, after furnishing it with small branches, passes into the organ near the middle. The third trunk, after leaving the skull, divides two branches which pass to the electric organ through the gills; one between the second and third openings, the other between the third and fourth, giving small branches to the gill itself. These nerves having entered the organs, ramify in every direction between the columns, and send in small branches on each partition, where they are lost.

The nerves bestowed on these organs, in proportion to their size, must, on reflection, appear as extraordinary as the phenomena they afford. Nerves are given to parts either for sensation or action. Now, if we except the more important senses of seeing, hearing, smelling, and tasting, which do not belong to the electric organs, there is no part, even of the most perfect animal, which, in proportion to its size, is so liberally supplied with nerves; nor do the nerves seem necessary for any sensation which can be supposed to belong to the electric organs. And, with respect to action, there is no part of any animal, with which I am acquainted, however strong and constant its natural actions may be, which has so great a proportion of nerves. If it be then probable, that these nerves are not necessary for the purposes of sensation or action, may we not conclude, that they are subservient to the formation, collection, or
management of the electric fluid; especially as it appears evident, from Mr Walsh's experiments, that the will of the animal does absolutely controul the electric powers of its body, which must depend on the energy of the nerves.

In Fig. 1. we have given a representation of the under surface of a female torpedo. Below a is seen the right electric organ displayed by flaying off the skin b, c are the nostrils in the form of a crescent, d the mouth in a crescent contrary to that of the nostrils, and furnish ed with several rows of small hooked teeth, e the bronchial apertures, five being on each side, f the place of the heart, g g g the place of the anterior transverse cartilages, h h the exterior margin of the great lateral fin, i i its inner margin confining with the electric organ, k the articulation of the great lateral fin with the scapula, l the abdomen, m m the place of the posterior transverse cartilage, which is single, united with the spine, and supports the smaller lateral fins on each side, n n n the two smaller lateral fins, o the anus, and p the fin of the tail.

Mr. Geoffroy has more recently examined the anatomy of the other electric fishes, and has not obtained, in the case of the torpedo, results differing greatly from those of Dr. Hunter. He has analysed the fluid which is contained in the cells of the hexagonal tubes, and has found that it is composed of albumen and gelatine; he also found organs analogous to those of the torpedo in other species of the ray, which do not exhibit any electrical properties. This transparent gelatinous fluid was considered by Dr. Ingenhousz as the reservoir of the electric power.

As the experiments of Mr Walsh were not considered as affording a sufficient proof of the identity of the shock of the torpedo with that produced by a Leyden phial, Mr Cavendish made an attempt to imitate the effects of the torpedo by electricity. The principal difficulty that required explanation was the production of a shock when the fish was held under water, and in other circumstances, where the electricity had a much greater passage than through the person's body. Mr Cavendish explains this by stating, that when a communication is made between the positive and negative side of a jar by any number of different circuits, some electricity will pass along each, and a greater quantity through those in which it meets with the least resistance. In like manner, when any person lays one hand on one surface of the electric organ of the torpedo, and his other hand on the other surface of the organ, a part of the fluid will pass through his body; but if one of his hands is laid on the tail instead of the other surface of the organ, part of the fluid will still pass through him, though less in this case than before. Owing to the moistness of the body of the torpedo, some electricity will pass through him even if his hands are laid upon any two parts of the animal, provided one of these parts is nearer to the upper surface of the organs than the other. Upon the same principle, if the torpedo is plunged in water, the electricity will pass through the water in all directions, and even to great distances from the body of the animal; and the nearer any part of the water is to the fish's body, the greater quantity of fluid will be transmitted. Hence if any person touches the fish in this situation, either with one of his hands on the superior surface of its electric organ, and the other on the inferior one, or in any of the other ways formerly mentioned, a certain quantity of the electricity will pass through his body, but certainly less than when the shock is received in the air; and the same thing will happen, even if he does not touch the fish at all, but plunges his hands in the water; so that one hand is nearer the upper surface of the electrified organs than the other. The second difficulty which requires explanation, is, that no spark, or sound, or electrical attraction is perceived. In order to explain this, Mr Cavendish made experiments with a number of jars, for the purpose of finding through what distance the electric spark will fly when a shock of a given magnitude is contained in one or more jars. The result of these experiments was, "that the distance to which the spark will fly is inversely in a rather greater proportion than the square root of the number of jars." That is, a charge of a certain magnitude contained in 4 jars passes through a space of \( \frac{1}{\sqrt{4}} \) of an inch. The same charge when contained in 100 jars will scarcely pass through \( \frac{1}{\sqrt{100}} \) of an inch. Hence the torpedo may contain as much electricity as will give a shock, without being able to make it pass through such a space of air as is necessary to produce the electric spark. Mr Cavendish explains the absence of attraction and repulsion by the analogous fact, that, in a large battery, so weakly electrified, that its shock will not pass through a chain, which is the case with the torpedo, a pair of pith balls suspended from the discharging rod will not exhibit any divergence.

In order to establish these conclusions more completely, Mr Cavendish endeavoured to make an artificial artificial torpedo of wood, connected with glass tubes and wires, and covered with a piece of sheep skin leather. The difference, however, between the shock given through this torpedo, by means of the charge of a battery, in air, and in water, was too great, and therefore Mr Cavendish substituted thick leather for the wood. This instrument was almost an exact imitation of the real torpedo. In air, the shock was felt chiefly in the elbows, whereas under water it was felt chiefly in the hands. A weaker shock, but one of the same kind, was experienced when Mr Cavendish, instead of touching his artificial torpedo, held his hands under water at two or three inches distance from it. When this torpedo was touched below water with only one hand, a shock was experienced as strong as if it had been touched by both. When it was touched below water with two metallic spoons, it gave no shock; but in the air it was very strong.

Mr Cavendish was likewise able to imitate the torpedo in its power of giving a shock to those who trample upon it with shoes on their feet, and when it is buried in sand; but he could not sufficiently explain the remarkable fact stated by the fishermen, that they often received a shock through their nets when the fish was 12 feet distant from their hands. As it is necessary to suppose that the torpedo is provided with a large battery, Mr Cavendish has endeavoured to compute its magnitude in the torpedo examined by Mr Hunter. Mr Cavendish's battery was composed of 49 jars of very thin glass, and appears to have contained about 76 feet of coated surface; and he calculates that the torpedo allowed to contain 14 times as much electricity as this battery, or was equal to 106 feet of coated glass.

Mr Nicholson has followed Mr Cavendish, with much ingenuity, in explaining the anomalous phenomena of the torpedo, by the principles of common electricity; but we cannot find room for prosecuting this subject any further.

When the Galvanic or Voltaic pile was discovered, philosophers imagined that they would find a striking analogy between its action and that of the torpedo, as
fluids seemed in both cases necessary to the development of the electrical effects. Volta, himself, believed, that among the humid substances of which the electric organ of the torpedo is composed, are some adapted to excite the electric virtue by their mutual contact, and others to transmit it; and hence he supposes, that the superposition of the different cells formed by those substances corresponds to that of the metallic and moist conductors, of which the pile consists. This analogy, however, is more imaginary than real. Messer Humboldt and Gay Lussac remark, "that they would rather be inclined to compare their action to a chain of small Leyden phials than to the pile of Volta." - The nerves,"say they, "without doubt, act the chief part in the production of these phenomena; and the physiologist, who takes a general and enlarged view of the vital actions, would, with reason, oppose the ideas of the philosopher, who conceives he can explain the whole by the contact of the albumino-gelatinous pulp with the tenacious sepa which nature has conferred in the formation of the organs of the torpedo."


2. On the Electricity of the Gymnotus Electricus.

The gymnotus electricus, or the electrical eel of Surinam, possesses electrical properties different from those of the torpedo. The properties of this fish were first made known to philosophers by M. Richer, upon his return from measuring the length of the pendulum at Cayenne. This fish was mentioned by Condamine, under the name of Purana, and its electrical properties have been successively noticed by Perrere, Fermin, Bancroft, and Vanderlott, the latter of whom speaks of its medicinal effects. At the desire of the Academy of Sciences, the experiments of Vanderlott were repeated and confirmed by M. Bajon, at Cayenne, in 1773. The most correct experiments, however, which have been made with it, owe to Dr Hugh Williamson of Philadelphia, Dr Martin of Charleston, and Mr Walsh. The following are the most interesting results which they obtained:

1. When the eel was touched with the hand, a shock was experienced in the fingers, and often in the wrist and elbow.

2. When the gymnotus was touched with an iron rod 12 inches long, the shock was experienced in the finger and thumb which held the rod.

3. If the hand of any person is held in the water, at the distance of three feet, when another person provokes the eel by touching it, he will feel a less painful sensation than if he had touched the eel itself.

4. When a cat-fish was thrown into the water to the eel, Dr Williamson put his hand in the water at some distance, and watched what took place. The gymnotus swam up to the cat, but turned away without offering any violence. It soon returned, however, and viewing the cat-fish for some seconds, gave it a shock which made it turn up its belly and continue motionless. At this time Dr Williamson felt a shock in his fingers, as in experiment 3. When any of the fish that were thus rendered motionless by the eel were taken into another vessel, they always recovered.

5. When the eel was touched and provoked with one hand, and the other was held in the water at a small distance, a shock passed through both arms, as with the Leyden phial.

6. When the end of a wet stick was held in the water with one hand, and the eel was touched with the other, a shock passed through both arms.

7. When the preceding experiment was made by two persons joining hands, the shock passed through them both.

8. When one of two persons joining hands touched the head roughly, while the other touched the tail gently, they both received a severe shock.

9. When the first of 8 or 10 persons joining hands touched the eel, while the last put his hand in the water at some distance from it, they all received a gentle shock.

10. When the first of the 8 pinched the tail, while the last touched the head, they all received a severe shock.

11. When two persons laid hold of the two extremities of a brass chain, and one of them put his hand in the water, while the other touched and irritated the eel, the shock passed through both.

12. If a silk handkerchief is wrapped round the hand, and the eel is touched with it, no shock is experienced, though another person will feel the shock, who puts his hand into the water at a little distance from the eel.

13. The communication between two persons was formed by various bodies, such as charcoal, iron, brass, dry wood, glass, silk, &c. and it was always found that the shock of the eel was conveyed through those substances that conduct common electricity, while it refused to pass through non-conductors.

14. The shock was not conveyed by a brass chain, unless the chain was stretched, or the shock severe.

15. When an insulated person was electrified by the eel, he exhibited no marks of electricity, nor did cork balls diverge when suspended by silk threads over the eel's back, or when touched by the insulated person when he received the shock.

16. A person, holding a Leyden phial in one hand, put his hand to the tail of the fish, while another, holding a short wire in one hand that communicated with the inside of the phial, grasped the fish near its head, he received a severe shock in his hand and arms.

17. Two pieces of brass wire, about one-sixth of an inch thick, were rounded at the ends, and fixed at the distance of the hundredth part of an inch in a frame of wood, then when one person held the farther end of one of the wires, while a second person held the end of
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the other, as soon as one of them touched the eel, the other having his hand in the water near it, they received a shock. This experiment was repeated 15 or 20 times with various success. When the distance of the wires was one-thirteenth of an inch, the shock never passed between them. Dr. Williamson, however, was not able to see the electric spark between the two metallic points, which he described to the bad state of health of his gymnotus. Mr. Walsh repeated this experiment in a different manner. He applied to a piece of glass a sheet of pewter, in which he had left a small separation or slit. This sheet had its two edges in communication with the body, through which the electricity of the fish was discharged. At the instant of the discharge, he perceived an electric spark, which went beyond the little interval made in the sheet. The success of this experiment depends on the fish being in the open air; for when it is immersed in water, the spark is not visible. M. Humboldt observed when he was in South America, that the gymnotus gave the most frightful shocks, without making any external motion of the eyes, head, or fins, like the torpedoes.

The preceding experiments were made upon a gymnotus kept in a large vessel, and supported by pieces of dry timber about 3 feet above the floor. A small hole was bored in the vessel, and when any person provoked the eel, another person holding his finger in the stream running through this hole received the shock. From the different experiments which he made, Dr. Williamson concludes, that the gymnotus has the power of communicating a painful sensation to animals that touch or come near it; that this effect depends solely on the will of the eel; that it has the power of giving a small shock, a severe one, or none at all; that the shock does not depend on the muscular action of the eel, but has the same effect as that produced by common electricity.

In order to convey to our readers an idea of the structure of the gymnotus, we have given a representation of it in Plate CCXVI. Fig. 2, where the skin is removed to shew the electrical organs. The lower surface of the head is shewn at A; the cavity of the belly at B; the anus at C; the fin at D; the back of the fish, when the skin has not been removed, at E; the fin which extends along the lower edge of the fish at FF; H, H, H, are the lateral muscles of the above fin, removed and carried back with the skin to expose the small organs; I is part of the muscle left in its place; KKK is the large electrical organ; LLL the small electrical organs; m m m the substance which separates the large organ from the small one; and n the place where this substance is removed.

From a minute examination of the electrical organs of the gymnotus, Dr. Hunter found, that they occupy nearly one half of that part of the fish in which they are placed, and constitute perhaps more than one-third of the whole fish. The animal possesses two pairs of electrical organs of different sizes, and placed on different sides. The large organ KKK occupies the whole of the lower and the lateral part of the body, constituting the thickness of the fore part of the animal, and stretching from the abdomen to near the end of the tail, where it terminates almost in a point. The two organs are separated at the upper part by the muscles of the back, at the middle part by the air bag, and at the lower part by the middle partition. The small organ extends along the lower edge of the animal almost as far as the other, terminating almost insensibly near the end of the tail. The two small organs are separated from one another by the middle muscle, and by the bones in which the fins are articulated. In order to perceive the large organ, it is necessary merely to remove the skin, which adheres to it by a loose cellular membrane; but in order to perceive the small organ, we must remove the long row of small muscles which move the fin. The organs consist of two parts, viz. flat partitions or septa, and cross divisions between them. These septa are very thin and tender membranes placed parallel to one another; they stretch in the direction of the length of the fish; and having their breadth nearly equal to the semi-diameter of the animal's body, the length of the septa are different, some of them being as long as the whole body. The distances between the septa vary with the size of the fish. In one two feet four inches long, their distance was nearly 1/4 of an inch; and in the broadest part of the organ, which was an inch and a quarter, there were 34 septa. The small organ has the same kind of septa, but they stretch in a direction somewhat serpentine. Their distance is only about 1/14 part of an inch; and in the breadth of the organ, which is half an inch, there are fourteen septa. Mr. Hunter is of opinion, that the septa answer the same purpose as the columns in the torpedoes, forming walls or abutments for the subdivisions, and constituting so many distinct organs. These septa are intersected transversely by very thin plates or membranes, whose breadth is the distance between any two septa, and therefore of different breadths in different parts; broadest at the edge, which is next to the skin; and narrowest at that next to the centre of the body, or to the middle division which divides the two organs. The lengths of these membranes are equal to the breadths of the septa between which they are situated, and there is a regular series of them from one end of any two septa to the other end. In one inch, there are no fewer than 540 of these transverse membranes.

The gymnotus examined by Dr. Hunter was not of a large size. Dr. Garden saw one 3 feet 8 inches long; and Dr. Bancroft was told when he was at Guiana, that some of these fish have been seen in the Surinam river upwards of 20 feet long, whose shock proved immediately fatal to those who received it.

Redi, Perrault, and Lorenzini, believed that the electricity of the torpedoes was owing to the emission of an infinite number of corpuscles continually proceeding from the fish, and which, by penetrating animal bodies, benumbed them by their accumulation. It was the opinion of Borelli, that it communicated a trembling to the nerves, which deadened the member in which it was produced. The most extraordinary notion, however, was that of Schilling, who imagined that he had discovered sensible magnetic effects in the gymnotus. He maintains, that when this eel was placed near a loadstone, it was attracted by it, and adhered to it; and became so languid when separated from the loadstone, that it might be touched with impunity. He observes, also, that the loadstone which he used appeared to be covered with particles of iron; and that, when the fish was placed in water containing iron filings, it became lively and vigorous. These experiments were carefully repeated by Ingenhouz and Spallanzani, who were unable to perceive any such magntetical effects. M. Hahn, professor of medicine at Leyden, remarks, that the rivers in America in which the gymnotus is found, carry along in their current a magnetic sand; and he supposes, that grains of this sand adhering to the glutinous skin of the fish, might have been the cause of the illusions by which Schilling was misled in his experiments.
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For further information respecting the gymnotis electricus, see Richer, Mem. Acad. Par. 1677, tom. i. p. 116.


3. On the Electricity of the Sillurus Electricus.

The sillurus electricus is a fish about 20 inches long, very broad in the fore part, and of a circumstance colour, with a few blackish spots towards the tail. It was found in some of the rivers of Africa, particularly in the Niger by Adanson, and in the Nile by Forskal; and when it is touched it gives an electrical shock; which is much feebleer than that of the torpedo or the gymnotus. When laid on the hand, and touched with an iron rod six feet long held in the other, the shock is distinctly felt. The inhabitants on the Nile call it Reusch, the same name which they give to the torpedo; and the Egyptians eat its flesh, and salt its skin, to which they ascribe an aphrodisiac quality. This fish is described by Forskal under a wrong name, and was found to be a sillurus by Brossonet. This fish is called Onaeniam by the Negroes, from its electrical property; and Le Trembleur du Senegal by the French. The fish is represented in Plate CCXLVI. Fig. 3.

According to M. Geoffroy, who examined the electrical organs of this fish, they are much less complicated than those of the torpedo and gymnotus. In the sillurus, this organ lies immediately below the skin, and stretches all round the body of the animal. The organ is composed of a collection of cellular tissue, so extremely thick and compact, that it resembles at first a stratum of lard, till the microscope informs us that it is composed of tendinous or aponeurotic fibres, interwoven with each other, and forming a reticulated mass, of which the meshes may be distinctly seen. As in the torpedo and gymnotus, these cells are filled with an albuminous gelatinous matter. All communication is prevented in the inside by a very strong aponeurosis, extending over the whole reticulation, and adhering very closely to it. It is also covered above this with a thick layer of fat. The nerves distributed over the electric organ of this fish proceed from the brain, and are the same with those found in all other fishes under the lateral line of the body. The two nerves of the eighth pair have a direction and nature peculiar to this species. Approaching each other as they issue from the cranium, they descend and traverse the body of the first vertebra. They first introduce themselves through an orifice peculiar to each other, and then issue by one aperture on the opposite side. After reascending, they suddenly separate, and proceed under each of the lateral lines. They are then found lodged between the abdominal muscles, and the aponeurosis which extends over the articulated organ. They then send long branches beneath the skin, which proceed to the right and left to the principal nerve. These branches, which amount to twelve or fifteen on each side, penetrate the aponeurosis which lines the inner surface of the reticular tissue, and they are lost in the latter. See Adanson, Voyage au Senegal, 1757, p. 135; Bourdonnet, Mem. Acad. Par. 1782, p. 692; Rouzet, Observations, &c. vol. xxvii. p. 139; Geoffroy, Bulletin de la Société Philomatique, tom. iii. p. 169; Annales du Museum d'Hist. Nat.; and Phil. Mag. vol. xv. p. 126.

4. On the Electricity of the Trichurus Indicus.

This fish inhabits the Indian seas, and possesses the electrical faculty like the sillurus electricus. So far as we know, its electrical organs have not been examined by anatomists.

5. On the Electricity of the Tetraodon Electricus.

This fish was discovered, by Lieutenant William Patterson, to possess the power of giving an electrical shock. He met with it on his way to the East Indies, in the Island of Johanna, one of the Comoro Isles. It is 7 inches long, 2½ inches broad, and has a long projecting mouth. It is of a dark brown colour on the back, of a sea green colour on the belly, yellow on the sides, and of a sandy green on the fins and tail. The body is covered over with red, green, and white spots, the latter being particularly bright. The eyes of the fish are large, and the iris is red, having its outer edge tinged with yellow. Mr. Patterson caught this fish in the cavities of the coral rocks, where the temperature of the water was 56° or 60° of Fahrenheit. Having caught two of them in a linen bag, he attempted to take one of them in his hand, when he received so severe an electrical shock, that he was obliged to quit his hold. He then carried them to the camp, which was about two miles distant, but on his arrival one of them was unfortunately dead, and the other in such a state of debility, that he was very desirous to establish without delay the existence of the electrical faculty, by the evidence of others. He therefore put it into a tub of water, and when the surgeon of the regiment endeavoured to lay hold of it by his hands, he received a distinct electrical shock. The adjutant afterwards touched it on the back with his finger, and experienced a slight shock. See the Philosophical Transactions for 1780. vol. xxxv. p. 382.

SECT. VIII. On the Spontaneous Electricity of the Human Body.

We have already had occasion, in our history of the science, to mention several electrical phenomena produced on the human body. These, however, were obviously generated by friction, and have therefore no connection with the present subject. Various instances have occurred in which sparks of electric light have been evolved during the combing of the hair, the rubbing of the breast and arms, and the pulling off of the under garments; but in these cases the electricity is excited by friction, and is strong or weak in different cases, according to the constitution of the individual, the dryness of the skin, the nature of the clothes, and the state of the surrounding air.

M. de Saussure made a great number of experiments on the electricity of his own body, which he examined by means of Volta's electrometer and condenser, but he does not seem to have observed that kind of electricity which is properly entitled to the name of spontaneous. As he never could discover any electricity in his own body when he was perfectly naked, he concluded that it was produced by the friction of the clothes against the skin. He could never find any electrical indications when his clothes were cold, or when his body was in a state of
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1. The electricity, he observes, was sometimes positive, and at other times negative, without my being able to ascertain the cause of these variations. It sometimes happened that the balls of the electroscope separated and collapsed in succession, when, being in a state of insulation, I made a great motion, and kept one of my hands applied to the electroscope. If, for example, after having bent my body forwards, I raised myself suddenly, I saw the balls diverge to a considerable distance, and then collapse, unless when I drew away my hand when they were in a state of divergence, and then continued in this state of divergence, and exhibited positive electricity. The electricity which appears in these experiments is obviously produced by the friction of the body against the clothes which cover it. The motion produced by respiration is sufficient of itself to excite a little electricity, for when a person remains upon the insulated stool in a state of the most complete repose that can be observed by a living being, sensible indications of electricity will be exhibited, if the hand is laid for some time on one of Volta's condensers. In order to succeed in these experiments, the clothes of the person must be warm by the heat of the body; for whenever cold clothes are put on, no electricity appears. The same thing takes place when the body is covered with perspiration. It must also be observed, that there are some individuals who give no signs of electricity. The knowledge of spontaneous electricity is not a matter of indifference in medicine; for however weak it may be, the action of it is anything necessary to influence the animal economy. Is it not, in part, this electricity which renders moderate exercise, and clothes moderately warm and dry, so favourable to insensible perspiration, and to all the secretions of the human body? These experiments of Saussure were repeated with the same results by Volta, Landriani, and the Abbe Bertholon.

The most successful experimenter, however, on this branch of electricity was M. J. J. Hemmer, who has published a full account of his experiments in the 6th volume of the Transactions of the Electoral Academy of Sciences at Mannheim. In order to examine the electricity of his own body, he insulated himself upon a board supported by glass feet, and then touched for half a minute; or less, the plate of a condenser of his own invention. The condenser was then applied to a glass electroscope, as improved by Saussure, and by means of a glass tube rubbed with woollen cloth, he examined the electricity of the diverging balls. His experiments were made on the 21st February 1786, and have since been repeated, both upon himself and upon persons of various ages and constitutions, upon persons in motion and at rest, dressed or undressed, fatigued or in good spirits, hot or cold, fasting or full, and sleeping or waking. The following are the principal results obtained by Mr Hemmer.

1. The electricity of the human body is common to all men, and it was found in 40 persons of all ages and both sexes; but in different persons it has different degrees of strength, and is positive in some and negative in others.

2. The strength and character of the electricity is often different in the same person. In 2422 experiments, M. Hemmer found it 1252 times positive, 771 times negative, and 399 times imperceptible. Out of 74 experiments made upon his maid, it was 17 times positive, 33 times negative, and 44 times imperceptible.

3. Although the electricity often changes in the course of the experiment, and even becomes imperceptible, yet the electricity of the human body appears to be naturally positive; for it always possesses this kind of electricity when exposed to no violent exertion. Out of 356 experiments made when he was sitting at rest, and when the natural heat of his body was not disturbed, M. Hemmer was 332 times in a state of positive electricity, 14 times in a state of negative electricity, and 10 times the electricity of his body was not perceptible.

4. Cold changes the natural or positive electricity into negative, or, at least, diminishes its intensity. Out of 62 experiments made upon himself, when he came from a temperature of about 82° of Fahrenheit, his electricity was 38 times negative, 15 times positive, and 7 times imperceptible.

5. Latitude impedes the positive electricity of the body, and changes it into the opposite. Out of 16 times that he walked backwards and forwards in his apartment, or was otherwise employed, Hemmer found the electricity only once weakly positive, ten times negative, and five times imperceptible. In 92 experiments made when he was standing at rest, the electricity was two times weakly positive, and 30 times imperceptible.


Sect. IX. On the Negative Electricity of Vitiated Air.

The production of negative electricity by the vitiation of atmospheric air, was first observed by Mr John Read of Knightsbridge. Having often noticed that the electricity of a small room in which he sat was negative, when that of the external air, and even that of the adjoining apartment, was positive, he began to suspect that this difference was owing to the vitiation of the air by respiration. In order to determine this point, he invited a friend into his room on the 9th of July 1793, when the weather was hot and serene, and the thermometer at 75°; and having shut up the doors and windows, he placed himself nearly in the middle of the room, and his companion at the side of it. At the end of 20 minutes, Mr Read was in a profuse perspiration, and having worked the doubler, he found the electricity negative. He then examined the electricity of his bedroom a little while before he went to rest, and found it positive; but when he rose at six o'clock next morning, he found that it had become negatively electrified. In a room which had been newly white washed and painted, and was therefore full of noxious effluvia, he also found the electricity negative.

Mr Read examined the electricity of the air in the charity-school at Knightsbridge, when it was vitiated by a great number of children, and he always found it strongly negative, while the schoolmaster's parlour adjoining to it was in a positive state; and on the 6th of July, when the thermometer was at 76°, Mr Read went to the same school, but finding the doors and windows open to admit fresh air, and experiencing no disagreeable smell, he thought it unnecessary to make the experiment. The schoolmaster, however, remarked that
there was one end of the room which was never free of smell, and Mr Read was therefore induced to work his doubled in that end. The electricity was here negative while in the other end of the school, and in the school-master's parlour it was positive. From these and other experiments, Mr Read concludes, that air infected with animal respiration or vegetable putrefaction is always electrified negatively, when at the same time the surrounding atmosphere is electrified positively. See the Philosophical Transactions, 1754, vol. lxxxiv. p. 266.

SECT. X. On the Electricity of the Atmosphere.

As the electrical phenomena which appear in the atmosphere, either during the ordinary changes to which it is subject, or during the violent perturbations into which it is thrown by the production of thunder and lightning, are evidently not produced by friction, or any similar cause, the consideration of this important subject belongs properly to the present Chapter. We shall, therefore, endeavour to include all the phenomena under three heads: 1. On the electricity produced in the atmosphere during its ordinary changes; 2. On the electricity exhibited during thunder and lightning; and, 3. On the electricity exhibited in luminous meteors.

1. On the Electricity of the Atmosphere during its ordinary Changes.

The earliest experiments on the spontaneous electricity of the atmosphere, were made in September 1752 by M. Le Monnier, at St Germain en Lay, and were laid before the Academy of Sciences in 1752. His apparatus consisted of a pole 32 feet high, insulated in the middle of a piece of turf. At its upper extremity was fixed a large and strong tube of glass, which carried a tube of white iron terminating in a point. Towards the middle of this tube was tied a small iron wire about 50 lines long, which was connected, without touching any other body, to a silk cord stretched in a horizontal position. M. Le Monnier observed, that there was always more or less electricity in the atmosphere, and he discovered that in dry weather, it increased from sun-ris when it was scarcely perceptible, to three or four o'clock in the afternoon when it was strongest, and that it afterwards gradually diminished till the fall of the dew, when it again increased, and afterwards diminished till it became almost insensible at midnight. This diurnal period was afterwards confirmed by Saussure and Beccaria.

In the following year, the same subject was prosecuted by the Abbé Mazeez at the Château de Maintenon, in the months of June and July. His apparatus consisted of an iron wire about 370 feet long, raised to the height of 90 feet above the horizon. It was brought down from a very high room in the castle, where it was fastened to a silk cord 6 feet long, and was carried from this to the steeple of the town, where it was fixed to another silk cord 3 feet long, and protected from rain. A large key was then suspended at the end of this wire to receive the electric matter.

From the 17th of June, when his experiments commenced, the electricity of the air was distinctly perceived, every day, from the rising of the sun to 7 or 8 o'clock in the evening, excepting in damp weather, when no indications of electricity appeared. When the weather was dry, minute bodies were attracted by the wire, if their distance was not greater than three or four lines, and he always found in weather not stormy that the electricity of the air was half as great as that of a stick of sealing wax 2 inches long. When he grasped the wire firmly in his hand, the electricity immediately ceased, and did not reappear till after an interval of 3 or 4 minutes. With the view of collecting a greater quantity of electricity, he added another wire, which communicated with an electrical-machine composed of pieces of iron, tin plates, gilt paper, &c. supported by silk cords; but he did not find that the electricity had become stronger. When he now grasped the wire firmly in his hand, it did not return till after a longer interval than before. The Abbé Mazeez likewise observed, that the electricity of the air was not increased with storms and hurricanes unattended with rain; for during a violent storm of wind, which continued without interruption for three days, in the month of July, he found it necessary to place the dust within four or five lines of the conductor, before it experienced a sensible attraction. No change was produced by the different directions of the winds. In the driest nights of summer, he was never able to observe any electricity in the air, but it always began to appear in the morning at sunrise, and vanished again in the evening at half an hour after the setting of the sun. In the month of July, in a very dry day, when the sky was serene, and the heat of the sun intense, he found the electricity to be stronger than he had ever observed it. The dust was then attracted at the distance of 10 or 12 lines from the conductor.

The electricity of the atmosphere, in its ordinary state, was observed also by Mr Kinnersley. He found that when the air was very dry, it always contained electricity, and he rendered this electricity visible by electrifying himself negatively, and extending his arm into the air when it was dark, with a long sharp needle. The electricity then appeared luminous as it converged to the point of the needle.

Signor Beccaria examined the subject of atmospheric electricity with particular attention, both by means of rods and electrical kites. He found that there was no perceptible electricity in the air, when the atmosphere was in the three following states. 1. When the weather was clear and windy. 2. When the sky was covered with slow moving clouds, and black clouds; and 3dly, When the weather was moist, and not actually raining. The electricity was always perceptible in a clear, calm, and calm weather and in rainy weather, without lightning, the electricity always appeared a little while before the rain fell, and when the rain was actually falling, but it disappeared a short time before the rain had ceased. These signs of electricity were always stronger, when his rods reached higher into the air, and when his electrical kites flew to the greatest height. Insulated strings extended in the open air acquired a degree of electricity which increased with the length. Having extended across the river Po a cord 1500 Paris feet in length, he found it as strongly electrified during a shower, unattended with thunder, as a rod of metal had been during a thunder storm.

The most complete series of observations on atmospheric electricity was made by M. de Saussure. The general results which he obtained are highly interesting, and although they are not given by him as completely established, yet they are well worthy of the attention of philosophers. He found that the electricity of the atmosphere varied with the situation. It was generally stronger in places the most elevated and isolated. It was imperceptible under trees, in the streets, in courts, and in general in any inclosed place.
It was, however, perceptible in towns, in the middle of large squares, on the sides of quays, but principally on bridges, where he found it much stronger than in the open country. It is more the relative than the absolute height of the place of observation that affects the intensity of atmospheric electricity. It is strongest, for example, at the angle of a terrace raised about 15 or 20 feet above the level of the country, than in the middle of a flat plain, or the top of a high hill; for as the angle of the terrace is more insulated, it has with the earth fewer points of contact, which deprive it of its electricity.

The intensity of atmospheric electricity is subject to great changes in the same place. When the weather is not serene, it is impossible to assign the law of these variations, as it does not seem to depend upon the time of the day, or upon any of the known modifications of the atmosphere. The reason of this is obvious. When contrary and variable winds prevail at different heights, when clouds are rolling above other clouds, those winds and clouds, which we cannot perceive, influence the stratum of air in which the experiment is made, and produce changes, of which we see only the effects. In stormy weather, for example, we observe the electricity strong, then become imperceptible, and afterwards recover its strength, become positive, and the next moment negative, without any apparent cause for these variations, which sometimes occur so rapidly that it is impossible even to note them down. When the weather is rainy, without being stormy, these variations are less sudden. The intensity of the electricity alone varies, being almost always positive in rainy or snowy weather. In cloudy weather, when it is neither rainy nor stormy, the electricity follows nearly the same laws as when the weather is serene. The intensity of the electricity is commonly diminished by strong winds, which bring the different strata of the atmosphere successively towards the ground, and this promotes the uniform distribution of the electric fluid between the air and the earth.

The state of the air, with the exception of stormy weather, when the electricity of the atmosphere is strongest, is during the prevalence of fogs, which are always accompanied with a very perceptible electricity, unless when they resolve themselves into rain, when sometimes no electricity is visible. At Geneva, the fogs are a pretty certain sign of good weather. They often do not rise to a great height above the surface of the earth; and when the low grounds are completely obscured, the sky is clear on the mountains. In these cases the fogs conduct to the earth the electricity of the serene air which reigns above them.

In winter and in clear weather, Saussure found that the electricity of the air was generally weakest in the interval which elapsed between the time when the falling of the dew had ceased in the evening, and the instant of the rising of the sun. Its intensity then gradually increased, and sooner or later, but almost always before mid-day, it reached a certain maximum, after which it diminished till the fall of the dew, when it is sometimes stronger than it has been during the whole day. It then gradually decreases during the night, but never becomes imperceptible, if the weather is perfectly clear. The electricity of the atmosphere has, therefore, a diurnal period like the sea, increasing and decreasing twice in 24 hours. Its intensity is a maximum some hours after the rising and setting of the sun; and it is weakest before the rising and setting of that luminary.

In order to give an example of this diurnal period, M. Saussure has selected the observations of the 22d of February 1785, which was one of the coldest days ever remarked at Geneva; and he has also given the observations made on the day which preceded and followed it. These results are contained in the following Table. The observations were made 60 feet above the level of the Lake of Geneva. The thermometer and hygrometer were suspended in the open air on a south-west terrace, and the electrometer gave the same electricity as if it had been placed under similar circumstances in an open plain, for the wall of the terrace increased this electricity as much as the neighbourhood of this house diminished it. The height of the barometer is reduced, according to the method of M. De Luc, to what it would have been if the mercury had been constantly at the temperature of 10° of Reaumur. A weak wind from the southeast prevailed almost constantly on the 21st, 22d, and 23d of February, when the observations were made.

Table, shewing the Electricity of the Atmosphere during three Days, at various Hours of the Day and Night.

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<td>Feb. 21st, 9 15 Morning</td>
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<td>11 10 Morning</td>
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<td>3 0 Evening</td>
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<td>6 0 Evening</td>
<td>26 6 0</td>
<td>- 5 2</td>
<td>85 0</td>
<td>1 0</td>
<td>Some clouds in the south west</td>
</tr>
<tr>
<td>7 0 Evening</td>
<td>26 6 2</td>
<td>- 8 8</td>
<td>89 0</td>
<td>1 8</td>
<td>Perfectly clear</td>
</tr>
<tr>
<td>8 0 Evening</td>
<td>26 6 3</td>
<td>- 10 0</td>
<td>95 0</td>
<td>2 0</td>
<td>Idem</td>
</tr>
<tr>
<td>9 0 Evening</td>
<td>26 6 3</td>
<td>- 10 6</td>
<td>95 7</td>
<td>1 8</td>
<td>Idem</td>
</tr>
<tr>
<td>10 0 Evening</td>
<td>26 6 1</td>
<td>- 9 9</td>
<td>99 1</td>
<td>1 5</td>
<td>Little clouds near the horizon, in the S.</td>
</tr>
<tr>
<td>11 0 Evening</td>
<td>26 6 0</td>
<td>- 12 3</td>
<td>99 1</td>
<td>1 5</td>
<td>Idem more extended towards the S. W.</td>
</tr>
<tr>
<td>12 0 Evening</td>
<td>26 5 15</td>
<td>- 12 5</td>
<td>99 1</td>
<td>1 5</td>
<td>Idem</td>
</tr>
<tr>
<td>22d, 1 0 Morning</td>
<td>26 6 0</td>
<td>- 14 3</td>
<td>Idem</td>
<td>0 9</td>
<td>Idem</td>
</tr>
<tr>
<td>2 0 Morning</td>
<td>26 6 8</td>
<td>- 14 5</td>
<td>Idem</td>
<td>1 2</td>
<td>Clouds increase and approach one another</td>
</tr>
<tr>
<td>6 15 Morning</td>
<td>26 5 7</td>
<td>- 15 0</td>
<td>Idem</td>
<td>0 8</td>
<td>Clear</td>
</tr>
<tr>
<td>7 30 Morning</td>
<td>26 5 4</td>
<td>- 14 7</td>
<td>Idem</td>
<td>1 2</td>
<td>Very light fog</td>
</tr>
<tr>
<td>8 10 Morning</td>
<td>26 5 2</td>
<td>- 14 2</td>
<td>Idem</td>
<td>1 1</td>
<td>Idem</td>
</tr>
<tr>
<td>9 10 Morning</td>
<td>26 4 15</td>
<td>- 10 7</td>
<td>Idem</td>
<td>1 6</td>
<td>Idem</td>
</tr>
</tbody>
</table>
It appears from the first 18 observations of the preceding Table, which were made in an interval of 26 or 25 hours, during which the sky was perfectly serene, that the electricity of the atmosphere was very strong about nine o'clock in the morning; that it diminished gradually till six o'clock in the evening, when the first minimum took place; that it afterwards increased till eight o'clock, when it reached its second maximum; that it then diminished again, making some oscillations, till six o'clock of the following morning, when it reached its second minimum; and then increased again till ten o'clock in the evening, when it was again at a maximum.

The weather, however, being how cloudy, the periods became less regular.

In summer, the electricity of clear weather is much weaker than in winter. Saussure has observed the pith balls diverge two lines in winter in an open country; whereas in summer their greatest divergence did not exceed a line, at least when the sky was perfectly serene, for in the time of a storm they often diverged as remote as the threads permitted them. The weakness of the electricity of clear weather in summer renders the diurnal period less regular and less distinct; for since its fundamental quantity is very small, accidental causes, such as winds, and different quantities of humid vapour and dry exhalations that exist in the air, disturb the regularity of the diurnal period, and make the maximum and minimum fall in points opposite to what they would have done in cloudy weather.

In summer, when the ground has been dry for some days, the electricity of a dry and warm day generally increases from the rising of the sun, when it is almost insensible, to three or four o'clock in the afternoon, when it attains its greatest force. It then gradually diminishes till the fall of the dew, when it recovers its strength; and afterwards becomes almost imperceptible during the night. We have already seen that this diurnal period was first noticed by Le Monnier. It was afterwards determined with more exactness by Becquerel, and Dr. Cardini obtained a similar result. None of these writers, however, have noticed the diurnal period in winter which we have just described from Saussure. It is very remarkable, also, that this period is the same in summer in those clear days which follow rainy days, the electricity diminishing towards the middle of the day.

In serene weather the electricity of the atmosphere is invariably positive, both in summer and in winter, during the day and night, at the rising of the sun and at the falling of the dew; and in short at every time when there are no clouds in the sky. It is impossible, therefore, not to conclude with Volta, that the electricity of the atmosphere is essentially positive, and that when negative electricity does exhibit itself in snow, rain, and in storms, it arises from the clouds being exposed to the pressure of the electric fluid contained in the upper regions of the atmosphere, or in clouds more elevated than themselves. These clouds discharge a part of their electricity into the earth or into other clouds, and are thus electrified negatively by the effect of an electricity originally positive, in the same manner as an electrometer acquires a permanent negative electricity when it is touched at the instant that the air is positively electrified.

The interesting results obtained by Saussure of which we have given a very full account, cannot be considered as of general application to climates different from that of Geneva. Hence it becomes a matter of importance to have observations made in different parts of the globe, in order to ascertain the local causes by which the electricity of the atmosphere may be affected. Mr. Thomas Ronayne made a series of observations on the electricity of the atmosphere in Ireland, and obtained the following results: He found that the air in Ireland was always charged with positive electricity in winter, at a proper distance from buildings, masts of ships, &c. The electricity was diminished in frost, foggy, or misty weather, and in calm and cloudy weather it was still perceptible. In summer he was never able to discover any electricity, excepting when a fog came on in the cool of the evening, or at night, and then it was always positive, but weaker than in winter fogs. When a fog became very thick, Mr. Ronayne remarked that the electricity diminished, but again recovered its strength when the fog returned to its former state. When rain fell in foggy weather, the electricity became imperceptible, but reappeared with the fog. When fogs, floating near the earth, became very dense, the electricity is...
ELECTRICITY.

imperceptible, but when the fogs were situated high in the air the reverse took place. Mr. Henley found from 20 experiments, that the electricity of a thick fog separated the balls of an electroscope from \( \frac{1}{2} \) to \( \frac{1}{4} \) of an inch.

Mr. Cavallo made a great number of valuable experiments on atmospheric electricity, both with an electrical kite, and another instrument of his own invention, which he calls an atmospheric electrometer. * These experiments with the electrical kite afforded the following general results:

1. The air appears to be at all times charged with positive electricity, which is stronger in frosty than in warm weather, and is by no means less in the night than in the day time.

2. The electricity of the kite is generally diminished by the presence of clouds. They very seldom increase it, and produce sometimes no effect whatever.

3. The electricity of the kite is generally negative, and very seldom positive in the time of rain.

4. The electricity of the kite is not affected by the aurora borealis.

5. The electrical spark from the string of the kite, or any insulated conductor connected with it, is seldom longer than a quarter of an inch, but is extremely puny. When the index of the electrometer does not indicate more than 20°, the person who receives the shock feels its effect in his legs, and the effect of it resembles more the discharge of the Leyden phial, than a spark taken from the prime conductor.

6. The electricity of the kite is in general stronger or weaker, according as the string is longer or shorter.

In the course of the experiments from which these conclusions were deduced, Mr. Cavallo met with a singular example of a powerful electricity existing in the atmosphere, when there was neither thunder nor lightning, and when there was none either for three days before or three days after the observation. Independent of the importance of the observation itself, it affords a useful lesson respecting the precaution which ought at all times to be taken by those who are engaged in examining the electricity of the atmosphere. As the account of it, given by Cavallo, will not admit of abridgment, we shall present it in his own words.

"October the 18th. After having rained a great deal in the morning and night before, the weather became a little clear in the afternoon, the clouds appearing separated, and pretty well defined. The wind was west, and rather strong, and the atmosphere in a temperate degree of heat. In these circumstances, at three P.M. I raised my electrical kite with three hundred and sixty feet of string. After that the end of the string had been insulated, and a leather ball, covered with tinfoil, had been hung to it, I tried the power and quality of the electricity, which appeared to be positive, and pretty strong. In a short time a small cloud passing over, the electricity increased a little; but the cloud being gone, it decreased again to its former degree. The string of the kite was now fastened by the silk lace to a post in the yard of the house wherein I lived, which was situated near Islington, and I was repeatedly charging two coated phials, and giving shocks with them. While I was so doing, the electricity, which was still positive, began to decrease, and in two or three minutes it became so weak, that it could be hardly perceived with a very sensible cork ball electrometer. Observing at the same time that a large and black cloud was approaching the zenith (which, no doubt, caused the decrease of the electricity) indicating imminent rain, I introduced the end of the string through a window, in a first-floor room, wherein I fastened it by the silk lace to an old chair. The quadrant electrometer was set upon the same window, and was, by means of a wire, connected with the string of the kite. Being now three quarters of an hour after three o'clock, the electricity was absolutely imperceptible; however, in about three minutes time, it became again perceivable, but now upon trial was found to be negative; it is therefore plain, that its stopping was nothing more than a change from positive to negative, which was evidently occasioned by the approach of the cloud, part of which by this time had reached the zenith of the kite, and the rain also had begun to fall in large drops. The cloud came farther on, the rain increased, and the electricity keeping pace with it, the electrometer soon arrived to 15°. Seeing now that the electricity was pretty strong, I began again to charge the two coated phials, and to give shocks with them; but the phials had not been charged above three or four times, before I perceived that the index of the electrometer was arrived at 35°, and was keeping still increasing. The shocks now being very smart, I desisted from charging the phials any longer; and, considering the rapid advance of the electricity, thought to take off the insulation of the string, in case that if it should increase farther, it might be silently conducted to the earth, without causing any bad accident, by being accumulated in the insulated string. To effect this, as I had no proper apparatus near me, I thought to remove the silk lace, and fasten the string itself to the chair; accordingly I disengaged the wire that connected the electrometer with the string, laid hold of the string, untied it from the silk lace, and fastened it to the chair; but while I effected this, which took up less than half a minute of time, I received about a dozen or fifteen very strong shocks, which I felt all along my arms, in my breast, and legs, shaking me in such a manner, that I had hardly power enough to express my purpose, and to warn the people in the room to keep their distance. As soon as I took my hands off the string, the electricity (in consequence of the chair being a bad conductor) began to snap between the string and the shutter of the window, which was the nearest body to it. The snapping, which were audible at a good distance out of the room, seemed first isochronous with the shocks which I had received, but in about a minute's time it altered; so that the people of the house compared their sound to the rattling noise of a jack going when the fly is off. The cloud now was just over the kite; it was black, and well defined, of almost a circular form, its diameter appearing to be about 40°; the rain was copious, but not remarkably heavy. As the cloud was going off, the electrical snapping began to weaken, and in a short time became unnoticeable. I went then near the string, and finding the electricity weak, but still negative, I insulated it again, thinking to keep the kite up some time longer; but observing that another larger and denser cloud was approaching space towards the zenith, as I closed then no proper apparatus at hand, to prevent every possible bad accident, I resolved to pull the kite in; accordingly a gentleman who was by me began pulling it in, while I was winding up the string. The cloud was now very nearly over the kite, and the gentleman, who

* A description of these instruments will be found in Part II. of the present article.
ELECTRICITY.

Descriptive Electricity.

was pulling in the string, told me that he had received one or two slight shocks in his arms, and that if he were to feel one more, he would certainly let the string go; upon which I laid hold of the string, and pulled the kite in as fast as I could, without any farther observation, being then ten minutes after four o'clock."

By means of the atmospheric electrometer, with which Cavallo made experiments several times a-day, during many months, he obtained the following additional results:

1. The electricity of fogs is always positive, like that of the atmosphere.

2. The electricity is always strongest in thick fogs, and in frosty weather, and weakest when it is cloudy and warm, and about to rain.

3. The electricity is strongest in elevated situations.

A series of interesting observations on the electricity of the atmosphere, were made by Mr John Read, at Knightsbridge, in the year 1789, 1790, and 1791, by means of an ingenious apparatus which we shall afterwards describe. The monthly results of his experiments in the year 1790, are given in the following Table, which was formed principally from the electrical signs afforded by the pith balls within his apartment. When the balls collapsed, and were not attracted by the finger, he wrote down that there were no signs of electricity. When they were attracted on the approach of the finger, but were not so strongly charged as to produce a divergence, he wrote down weak signs of electricity. When the balls diverged and collapsed on the approach of excited glass, he wrote down that the electricity was positive; but when the balls diverged still more, by the application of the excited glass, he wrote down that they were electrified negatively. When the divergence of the balls was one inch and upwards, visible sparks were drawn from a brass ball connected with the apparatus. The utmost limit of regular divergence was about 5 or 6 inches, above which it was very unsteady. The pith balls were nearly 1/64ths of an inch in diameter, and were suspended by very fine flaxen threads 5 inches in length. In carrying on these experiments, Mr Read was seldom absent one hour, excepting during the time of sleep; but whenever he left the apparatus for the evening, he examined the state of the electricity, and when the rod was unelectrified, he connected with it a Leyden phial, and next morning if the bottle was charged, he marked down the kind of electricity with which it was charged. In Mr Read's journal, is marked the state of the wind, the barometer, and thermometer for every day in the year, and the electric spark, the kind of electricity exhibited by pith balls, and the state of the balls themselves, and of the weather.

Table I. Electrical State of the Atmosphere in 1790.

<table>
<thead>
<tr>
<th>Time of Observation</th>
<th>Number of Times in which the Electricity was Positive</th>
<th>Number of Times in which the Electricity was Negative</th>
<th>Number of Days in which Sparks were perceived</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 days of May 1789</td>
<td>Positive 17</td>
<td>Negative 18</td>
<td>9</td>
</tr>
<tr>
<td>8 days of May 1790</td>
<td>Positive 32</td>
<td>Negative 36</td>
<td>12</td>
</tr>
<tr>
<td>June</td>
<td>Positive 13</td>
<td>Negative 22</td>
<td>12</td>
</tr>
<tr>
<td>July</td>
<td>Positive 19</td>
<td>Negative 19</td>
<td>9</td>
</tr>
<tr>
<td>August</td>
<td>Positive 9</td>
<td>Negative 23</td>
<td>7</td>
</tr>
<tr>
<td>September</td>
<td>Positive 17</td>
<td>Negative 7</td>
<td>7</td>
</tr>
<tr>
<td>October</td>
<td>Positive 12</td>
<td>Negative 8</td>
<td>8</td>
</tr>
<tr>
<td>November</td>
<td>Positive 12</td>
<td>Negative 6</td>
<td>7</td>
</tr>
<tr>
<td>December</td>
<td>Positive 12</td>
<td>Negative 4</td>
<td>13</td>
</tr>
<tr>
<td>January</td>
<td>Positive 26</td>
<td>Negative 0</td>
<td>3</td>
</tr>
<tr>
<td>February</td>
<td>Positive 26</td>
<td>Negative 1</td>
<td>3</td>
</tr>
<tr>
<td>March</td>
<td>Positive 28</td>
<td>Negative 12</td>
<td>8</td>
</tr>
<tr>
<td>April</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>241</strong></td>
<td><strong>150</strong></td>
<td><strong>98</strong></td>
</tr>
</tbody>
</table>

It appears from Mr Read's Journal, that there were only 7 days in the year in which the electricity was imperceptible, and only 73 in which weak signs of electricity appeared. The days in which no electricity appeared, were the 14th, 15th, and 23d of November, and the 6th, 15th, 17th, 21st, and 22d of December.

The following Table contains the summary of Mr Read's observations in 1791.

* This instrument will be described in Part II of the present article.
TABLE II. Electrical State of the Atmosphere in 1791.

<table>
<thead>
<tr>
<th>Time of Observation</th>
<th>Number of Times in which the Electricity was Positive.</th>
<th>Number of Times in which the Electricity was Negative.</th>
<th>Number of Days in which Sparks were perceived.</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 days of May 1790</td>
<td>Positive . . . 40</td>
<td>Negative . . . 27</td>
<td>Sparks drawn 13</td>
</tr>
<tr>
<td>8 days of May 1791</td>
<td>Positive . . . 45</td>
<td>Negative . . . 22</td>
<td>Sparks drawn 5</td>
</tr>
<tr>
<td>June . . . . . . .</td>
<td>Positive . . . 36</td>
<td>Negative . . . 23</td>
<td>Sparks drawn 8</td>
</tr>
<tr>
<td>July . . . . . . .</td>
<td>Positive . . . 33</td>
<td>Negative . . . 23</td>
<td>Sparks drawn 8</td>
</tr>
<tr>
<td>August . . . . . . .</td>
<td>Positive . . . 29</td>
<td>Negative . . . 38</td>
<td>Sparks drawn 14</td>
</tr>
<tr>
<td>September . . . . . .</td>
<td>Positive . . . 27</td>
<td>Negative . . . 11</td>
<td>Sparks drawn 10</td>
</tr>
<tr>
<td>October . . . . . . .</td>
<td>Positive . . . 21</td>
<td>Negative . . . 7</td>
<td>Sparks drawn 7</td>
</tr>
<tr>
<td>November . . . . . .</td>
<td>Positive . . . 12</td>
<td>Negative . . . 11</td>
<td>Sparks drawn 7</td>
</tr>
<tr>
<td>December . . . . . .</td>
<td>Positive . . . 10</td>
<td>Negative . . . 10</td>
<td>Sparks drawn 7</td>
</tr>
<tr>
<td>January . . . . . . .</td>
<td>Positive . . . 18</td>
<td>Negative . . . 10</td>
<td>Sparks drawn 7</td>
</tr>
<tr>
<td>February . . . . . .</td>
<td>Positive . . . 12</td>
<td>Negative . . . 10</td>
<td>Sparks drawn 7</td>
</tr>
<tr>
<td>March . . . . . . . .</td>
<td>Positive . . . 14</td>
<td>Negative . . . 8</td>
<td>Sparks drawn 5</td>
</tr>
<tr>
<td>April . . . . . . . .</td>
<td>Positive . . . 30</td>
<td>Negative . . . 8</td>
<td>Sparks drawn 8</td>
</tr>
<tr>
<td>Total</td>
<td>423</td>
<td>157</td>
<td>106</td>
</tr>
</tbody>
</table>

By comparing this Table with the preceding, it will appear that the differences in the electrical state of the atmosphere have been very considerable. Positive electricity appeared only 241 times in 1790, whereas it appeared 423 times in 1791. The number of times in which negative electricity appeared was nearly equal, being 156 times in 1790, and 157 times in 1791. The number of days in which sparks were drawn was 58 in 1790, and 106 in 1791. Mr Read, however, states, that the greater number of times in which positive electricity appeared in 1791, was partly owing to his having employed a better apparatus.

Mr Read has drawn the following conclusions from his numerous experiments on atmospheric electricity.

1. In a course of moderate weather, the electricity of the atmosphere is invariably positive, and exhibits a flux and reflux, in which it undergoes an increase and a decrease twice in every 24 hours.

2. The electricity is strongest about 2 or 3 hours after the rising of the sun, and some time before and after sunset; and it is generally weakest between noon and 4 o'clock.

3. The periodical electricity of the atmosphere seems to be manifestly influenced by heat and cold. Hence, it is obvious, why warm small rain is weakly electrified, while cold rain which falls in large drops is the most intensely electrified of any.

The most recent experiments on the electricity of the atmosphere have been made by Andrew Crosse, Esq. of Broomfield, near Taunton, by a very extensive atmospheric conductor, consisting of an insulated copper wire, 1/4th of an inch thick, extended between two vertical masts from 100 to 110 feet high. No exertion was spared to render this apparatus the most extensive and perfect that has been constructed. The insulated wire was made no less than one mile and a quarter in length, but having been exposed to depredations, and liable to injury from other causes, it was shortened to 1800 feet. Every contrivance has been tried to insulate this wire, but Mr Crosse has not yet been able to preserve the insulation during a dense fog or a driving snow. A contrivance was adopted to lower the insulators, for the purpose of cleansing them from spiders' webs; and it was necessary to fix the wire very securely, in order that it might be able to resist the weight of innumerable swallows that often perched upon it, and of wood pigeons and owls that often flew against it with considerable force.

This apparatus has been in use more than eighteen months, and has enabled Mr Crosse to draw the following important conclusions, many of which confirm the observations of preceding authors.

1st. The electricity is invariably positive in the ordinary state of the atmosphere. It is always weakest during the night. It increases at sunrise, then decreases towards the middle of the day; and regaining its strength as the sun declines, it again diminishes, and continues feeble during the night.

2d. Fogs, rain, snow, hail, and sleet, produce changes in the electrical state of the wire. The electricity is negative when they first appear. It frequently changes to positive, gradually increasing in strength; and then decreasing in a similar manner, and changing from positive to negative every three or four minutes. Those phenomena have been so constantly observed, that whenever the wire appears negatively electrified, it is considered as a certain indication, that either rain, snow, hail, mist, or a thunder cloud, is in the neighbourhood.

3d. The approach of a charged cloud at first sometimes produces positive and sometimes negative electricity; but whatever be the kind of the electricity which first appears, its intensity increases to a certain degree, and then diminishes and disappears, and is succeeded by the opposite electricity; which increases to a higher degree than the first had done, and then diminishes, and vanishes, and is again succeeded by the electricity which first appeared. These varying alternations of positive and negative electricity are often very numerous, and on different occasions succeed one another with different degrees of rapidity. The electricity, in general, becomes more intense at every repetition, till a copious and dense stream of sparks issues from the atmospheric conductor to the receiving ball, stopping at intervals, and returning with redoubled energy. Under these circumstances, a strong current of air proceeds from the wire, and the apparatus connected with it. Whenever the lightning flashes, an explosive stream, attended with a peculiar noise, passes between the balls of the apparatus, and throws a brilliant light on every surrounding object. When
the lightning is too powerful to permit the observer to carry on the operation in safety, he connects the insulated wire with the ground, and transmits the accumulated electricity in silence to the earth.

4th. During a driving fog, or a smart rain, the wire is electrified almost as powerfully as during a thunder-storm, and the electricity exhibits similar changes.

5th. A weak positive electricity generally prevails in cloudy weather. It often changes to negative when rain falls; but the positive electricity reappears when the rain has ceased to fall.

6th. The positive electricity is more intense in clear frosty weather than in a fine summer's day.

In the following Table, Mr. Crosse has given the different states of the air in which electricity appears, beginning with those in which it is most powerful.

1. During the occurrence of regular thunder clouds.
2. A driving fog accompanied by small rain.
3. A fall of snow, or a brisk hail storm.
4. A smart shower, especially in a hot day.
5. Hot weather succeeding a series of wet days.
6. Wet weather following a series of dry days.
7. Clear frosty weather, either in the night or day.
8. Clear warm summer weather.
9. A mackerel back or mottled sky.
10. A mackerel back or mottled sky.
11. Sultry weather, the sky covered with light hazy clouds.
12. A cold damp night.

13. A peculiar state of the atmosphere, which occurs during north-easterly winds, and which is regarded as particularly unhealthy, producing a sensation of dryness and extreme cold, which is not indicated by a depression of the thermometer.

A great number of experiments on atmospheric electricity have been made by Mr. Henley, Mr. Bennet, M. Achatel. M. Cotte. M. Erman, and various other authors, but we cannot find room to do any thing more than refer to their respective works.


2. On the Electricity of the Atmosphere as exhibited in Thunder and Lightning.

Although the existence of electricity in thunder storms is a modern discovery, yet there can be no doubt that the ancients were well acquainted with numerous phenomena that had the same origin.

Herodotus informs us, that the Thracians disarmed the heavens of its thunder, by throwing their arrows in the air; and that the Hyperboreans produced the same effect, by launching among the clouds darts armed with points of iron.

During the night before the battle which Postumius gained over the Sabines, the Roman javelins emitted a light like torches; and when Gylippus went to Syracuse, he perceived a flame upon his spear.* According to Procopius, the same appearance was seen in the war which Belisarius waged against the Vandals.† Livy ‡ informs us, that Lucius Atneas having bought a javelin for his son, who was about to be enrolled as a soldier, it threw out flames during two hours without being consumed by the fire. Similar facts are mentioned in Plutarch. and Pliny, and the last of whom observed the phenomenon himself. Cæsar informs us in his Commentaries, that in the African war, after a tremendous storm, which threw the Roman army into great disorder, the points of the darts of a great number of the soldiers shone with a spontaneous light. In the month of February, says he, about the second watch of the night, there suddenly arose a great cloud, followed by a dreadful storm of hail, and in the same night the points of the darts of the fifth legion appeared to be on fire. ¶

A very singular fact, analogous to those which we have now stated, is mentioned by Bianchini. There had existed from time immemorial, in one of the bastions of the castle of Duino, situated in the Frioul, on the banks of the Adriatic Sea, a pointed iron rod standing in a vertical position. In summer, when the weather had the appearance of being stormy, the soldier who mounted guard in this bastion, examined the iron rod, and presented to it the point of an iron halbert, which was always ready for this purpose, and whenever he perceived that the iron rod gave sparks, or displayed a small gerb of fire at its point, he rang a bell to give notice to the country people who were working in the fields, or to the fishermen who were at sea, that stormy weather was approaching. This custom was of great antiquity, and is mentioned by Imperati in a letter dated 1602. **

The production of electric light was no sooner discovered by Dr. Wall,†† than he noticed its resemblance to lightning; and the same remark was afterwards made by Gray,‡‡ who imagined that both the thunder and the

† Procopius De Bel. Vandalerum, ilib. ii. cap. 2.
‡ Livy, lib. 43.
§ In Sicilia millibus aliquot specula, in Sardiniis murus circumcunctum vigilioe equiti seipsum quem in manu tenetur. sallia, et litera crebris ignibus fuluisivi." Plutarch De Vit. Lycaeni.

** Vidit nocturnae militum vigiliae invernere pilas pro vallo fulgorem effigiea, hominia quoque capitis versipetoris horis magnis praesagens, circumcunctam." Plineus Hist. Nat. lib. 2.
† Per id tempus fere Cenarius exercitus exercitus, incenditione audita, nempe vigiliam igneo confection, eis cerifer vigiliae secunda nocte, iniunxerat cum saxa grandio subito est caeuros ingenios; eadem nocte legionis quintae calcinata sua sponte arrectum." Curs. Com. de Bello Africa. cap. 6. This phenomenon was considered as electrical by M. de Courtirion. See Mem. Acad. Par. 1758. p. 10.
‡‡ Alluding to this custom of the inhabitants of Duino, he observes, " Ignis et hastingi utn transient ad imbres, groundines, proces- tiamas praesagindae, tempore presentem ividito." See Mem. Acad. Par. 1764, p. 408, &c.

Early opinion of Dr. Wall and Mr. Gray.

See the History of Electricity, p. 412, col. 2.

See the History of Electricity, p. 412, col. 2.

On the electricity of the atmosphere as exhibited in thunder and lightning.
lightning were imitated in the artificial production of electricity.

The Abbé Nollet spoke still more decidedly respecting the analogy of electricity with lightning; and his opinion was probably formed from the following singular fact, which is related by Saussure: In the summer of 1732, when M. Paccard, the secretary of the parish of Chamouni, was excavating the foundation of a château, which he wished to erect in the meadow of l'Impré, upon Mount Breven, a violent thunder storm came on, and compelled him to take refuge under a neighbouring rock. In the place where he had been working he had left a large iron lever standing vertically in the ground, and he was astonished to observe the thunder and lightning, as he called it, fall several times upon the head of the lever. On the following winter M. Paccard went to Paris, and attended a course of lectures given by the Abbé Nollet; and as soon as he perceived the sparks from an electrifying machine, he was so struck with their resemblance to the fire which had fallen upon his lever, that he immediately communicated the observation to the Abbé Nollet. In the possession of such information, it is unaccountable how this learned philosopher should have neglected to try the experiments which, after the lapse of eighteen years, were made by his countryman Dalibard.

Dr Franklin, some time afterwards, drew up a list of the points of resemblance between electricity and lightning. Still, however, these conjectures had no solid foundation; and it is a singular fact, that no experiment had been made to verify a theory of such vast importance.

The celebrated naturalist Buffon, seems to have been the first person who made any attempt to draw down lightning from the heavens. Upon the tower of Montbar, he raised an insulated bar of iron, which he connected with a conductor and with balls, to give him notice at a distance of the presence of the electric fluid, and he waited with anxiety for the first storm of thunder.

At the recommendation of Buffon, M. Dalibard constructed a similar apparatus at Marly la Ville, about six leagues from Paris. It consisted of an iron rod 40 feet long and about an inch in diameter, and pointed at its upper extremity. The rod was bent at its lower end into two acute angles, and was placed in a garden upon three large poles, and insulated by means of silk strings, and a stool with glass feet. M. Dalibard, during his absence, entrusted the charge of his apparatus to a joiner named Coiffier, who had served 14 years in the dragoons, and who was supposed to have sufficient courage for such an undertaking. Dalibard had given him every requisite instruction, and had desired him, in the event of a thunder storm, to call in some of his neighbours, but particularly M. Raulet, the curate of the parish. In Dalibard's absence, the thunder storm made its appearance on Wednesday the 10th of May 1752, and between two and three o'clock in the afternoon, after a pretty loud clap of thunder, Coiffier ran to the apparatus, and presenting it to the end of an iron wire, insulated by a glass handle, he perceived a small spark attended with a cracking noise. He then drew a second spark, more brilliant than the first, and attended with a louder noise, and instantly called his neighbours as he was desired. The curate ran towards the apparatus with great impetuosity, and his parishioners imagined, from his great hurry, that Coiffier had been killed by the thunder. The alarm spread through the village, and in spite of the hail which followed the thunder, all the inhabitants flocked after their pastor. As soon as the curate arrived at the apparatus, he presented the insulated brass wire at the distance of about an inch and a half, and received a strong spark, which he describes as a small column of bluish fire, which smelt of sulphur, and which struck the end of the brass wire with great force. He repeated the experiment more than six times in the space of about four minutes, before several persons, and every experiment, to use his own words, "continued during the space of a pater and an ave." The sparks gradually diminished, and upon bringing the wire nearer the rod, he was able to draw only a few sparks, which soon disappeared. As soon as the cloud had passed, the curate dispatched Coiffier with a letter to Dalibard, containing the preceding statement. In the course of the experiments, M. Raulet had somehow or other received a stroke upon the arm, either from the rod or from the brass wire. Upon uncovering it, he perceived a mark, as if it had been made by a blow from the wire upon his naked skin.

A few days after the preceding experiment had been made, M. Delors, Demonstrator of Physics in Paris, who lived in one of the most elevated quarters of the town, had raised a bar of iron 90 feet high, insulated upon a cake of resin two feet square and three inches thick. On the 18th of May, between four and five o'clock in the afternoon, a stormy cloud passed over the apparatus, and M. Delors received several sparks from his rod, which resembled, in every respect, those which issued from ordinary electrifying machines. The strongest sparks were drawn at the distance of nine lines, whilst a shower of rain, mixed with a little hail, fell from the cloud, without either thunder or lightning. The conductor even gave sparks, when the cloud was over Vincennes, at least two leagues from the place of observation.

Buffon, though he had the merit of erecting the first thunder rod, was unluckily the last to observe any of its electrical phenomena. On the 19th of May, however, a stormy cloud at length passed over Montbar, and Buffon obtained from his rod several electrical sparks.

All these experiments were made in France, before Dr Franklin had raised his electrical kite in America; but without any knowledge of what had been done by the French philosophers, he succeeded in establishing the identity of lightning and electricity in the month of June 1752, and posterity have unanimously agreed in associating his name with that brilliant discovery. In our History of Electricity, we have already given a full account of the method by which he succeeded in bringing lightning from the clouds, and of the fatal accident which happened to Professor Richman of St Petersburg, in repeating that grand experiment.

No sooner was this great discovery published, than numerous attempts were made, in different parts of Europe, to obtain the same result. The Abbé Mazeau, Le Monnier, Rosas, Cassini, Bertier, Canton, Bevis, Wilson, Becarria, Muschenbroek, Kinnerley, Prince Gallitzin, van Swinden, Bertholon, De la Garde, Ver- rat, Marin, Zanotti, Bosc, Cordon, and other philosophers, succeeded in bringing down the electric fluid from the clouds, and have established, on the firmest basis, the identity of lightning and electricity.

The most successful, as well as the most meritorious

* See Saussure, Voyages dans les Alpes, 8vo edit. 1786, vol. iii. p. 79.
† See the History of Electricity, p. 417.
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...of all these philosophers, was undoubtedly M. de Romas, who had not only the merit of having first invented and used the electrical kite, but obtained, with it, a series of results, far surpassing, in magnitude and grandeur, those which had been obtained by Dr Franklin, or by any other philosopher.

Having observed, on the 12th of July 1753, that insulated rods gave stronger sparks, in proportion to their height in the atmosphere, M. Romas resolved to elevate a kite to the height of more than 600 feet, and he stated this plan in a letter to the Academy of Bourdeaux, on the 13th July 1752; and also mentioned it distinctly to M. le Chevalier Vivens, and several other individuals. This kite was seven feet five inches high, and three feet in its greatest width, with a surface of 18 square feet. The string of the kite was of cord, wrapped round with copper wire. On the 14th of May 1753, he raised it in the atmosphere without obtaining any indication of electricity, but on the 7th of June 1753, he was more successful. At one o’clock it thundered a little in the east, and at half past two, M. Romas had elevated his kite with a cord 750 feet long, and inclined at an angle of 45° nearly, so that the elevation of the kite was about 500 feet. To the extremity of the string he fixed a silk-en cord 3½ feet long, which was placed under the cover of a pent house, and had suspended to it a large stone, for the purpose of governing the motion of the kite. Near the junction of the string and the silk cord, was placed a tube of white iron, about a foot long and an inch in diameter. From which the sparks were to be seen as soon as the kite and the string were electrified. M. Romas also prepared a discharging rod, formed of a tube of glass 12 inches long and 3 lines in diameter, having at its end a tube of white iron, to which was fixed a chain of brass wire sufficiently long to touch the ground, when sparks were drawn from the first white-iron tube. By means of the discharging rod, he at first obtained sparks “as large as those produced by means of a good globe,” and several of his assistants drew sparks with a key and with the naked finger. These electrical phenomena were observed during about 22 minutes, and then disappeared. In the space of seven minutes the electricity reappeared, and again decreased, but only to manifest itself with additional force. New sparks were drawn by the fingers, the keys, the swords, and the canes of the spectators; and M. de Romas having presented the middle knuckle of his right hand, received a terrible shock, which struck him in the elbows, shoulders, knees, and the joints of his feet. Seven or eight of the bystanders, though they saw, from the convulsive motions of M. Romas, that he had received a very violent blow, did not hesitate to join hands, and received the sparks, which struck the feet even of the fifth person. The storm now increased—not a drop of rain had fallen; but in the zenith of the kite, and about 60° round it, there were black clouds, which indicated a great increase of electricity. Romas had therefore the prudence to receive sparks only by the discharger. At the distance of four inches, a spark, more than an inch long and two lines broad, was drawn in this manner, and, at the distance of six inches, Romas obtained several sparks two inches long. After this the electricity became so powerful, that instead of sparks, flashes of fire, about a foot long, three inches wide, and three lines in diameter, were repeatedly received, and the accompanying noise was heard at the distance of more than 500 feet. At this time, when he was more than three feet from the cord, Romas felt a sensation as if a spider’s web had been upon his face. He advised his assistants to keep at a greater distance, and when he himself was 5 feet from the string, he experienced the same sensation. He then retired still farther, and watched the phenomena which took place. There was no lightning, almost no sound of thunder, and no rain. The wind—which was in the east, blew strong, and supported the kite at an altitude of about 650 feet. Upon casting his eyes to the white-iron tube, at the junction of the string and the silk cord, which was about three feet distant from the ground, he was surprised to observe three straws standing erect, and dancing up and down below the white-iron tube. One of the straws was a foot long, another 5 inches, and the third 4 inches. This dance of the straws, which gave great delight to the spectators, lasted about a quarter of an hour, when a few drops of rain fell, and Romas again felt the former sensation upon his face, which indicated a new increase of electricity, and prevented him from drawing sparks even with the discharging rod. Having advised every person to keep at a greater distance, he perceived the longest straw attracted by the white-iron tube, and immediately heard three loud noises, which some compared to the crack of a postilion’s whip, and others to the sound of a large pot of earthenware dashed in pieces on the pavement. This clash was heard even in the centre of the town, and the experiment was made out of the town, in spite of the great noise which prevailed. The flash, which accompanied this explosion, had the shape of a spindle 8 inches long, and 4 or 5 lines in diameter. The straw which occasioned this noise, followed the string of the kite, and was seen even at the distance of 45 and 50 toises, going with great rapidity, being sometimes attracted, and sometimes repelled, and every attraction being accompanied with long plates of fire, attended with continual explosions. After the first spontaneous explosion, till the end of the experiment, there was no lightning, and almost no thunder. A phosphoric odour, peculiar to the electric matter, was distinctly smelt. Around the string there appeared a cylinder of permanent light, about three or four inches in diameter; and when the experiment was finished, they perceived in the ground, in a perpendicular direction, below the tube, a hole about an inch deep, and half an inch wide, which had probably been made by the large flashes of fire which accompanied the explosion. The wind having turned to the east, there was a heavy shower of rain, which was succeeded by hail, and it was no longer possible to keep the kite in the air. When the kite fell, the straw touched the roof of a house, and about 60 feet from the string being drawn in, the person who held it made the kite rise again, and immediately received such a violent shock in his arm, and throughout his whole body, that he was obliged to let it go. The string then fell upon the feet of one of the assistants, who also received a very violent shock.

On the 16th of August 1757, M. Romas was still more successful in his experiments. Although the storm was not great, there being almost no thunder, and very little rain, yet he obtained beams of fire nine or ten feet long, and about an inch thick, which were accompanied with a noise equal to that of a pistol. In less than an hour he obtained no fewer than 30 beams of this size, without reckoning a thousand others that were below...
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7 feet in length. These great flashes were spontaneous, and in spite of the abundance of fire which they formed, they constantly fell upon the nearest living body. This circumstance inspired M. Romas with confidence, and he did not hesitate to excite the fire with his discharging rod, at the time when the storm was most violent; and when the glass of which it was composed was two feet long, he was able to conduct, without feeling the slightest shock, beams of fire 6 and 7 feet long, with as much facility as he formerly conducted those which were scarcely 7 or 8 inches. In this experiment, the string of the kite was one half longer than it was in his other experiment; and he attributes the magnitude of the effects to the three following causes: 1. To the great length of the string. 2. To the continuity of the metallic wire which the string was wrapped round. And, 3. To the peculiar disposition of the clouds.

The identity of electricity being thus established by numerous and direct experiments, philosophers next attempted to observe the phenomena which accompanied the production of thunder and lightning, and to ascertain the manner in which they were generated by the electricity of the atmosphere.

When the sky is clear and serene, low and dense clouds begin to form in the atmosphere. They are spread over the heavens by a wind more or less violent, and are succeeded by others more thick and obscure. These clouds are agitated with various motions. While some of them are moving above in one direction, others are moving below them in an opposite direction. One cloud is seen to attract another, while others are separated by a repulsive force, and, in the midst of this universal agitation, other clouds are resisting immovable, in virtue of the opposing forces with which they are influenced. Amidst this conflict of opposite forces, flashes of blue light are seen to dart with inconceivable rapidity from one cloud to another, and, after the lapse of several seconds, the rumbling noise of distant thunder is faintly distinguished. The sky soon becomes more obscure, the lightning more frequent and vivid, and the thunder more loud, and succeeding the flashes of lightning at a shorter interval. A dreadful gloom is now spread over nature, and the sun almost seems to threaten the extinction of his feeble light. The husbandman retires from the fields; the fisherman forsakes his nets; the birds of the air desert their native element; the brate creation run up and down in wild dismay, or seek for shelter from the impending danger; and the sky and the fields are thus left unpeopled during this dreadful strife of the elements. The storm is now at its height, the accumulated electricity of the clouds is seen to strike towards the earth, striking the tallest oak in its passage. Such a stroke is often accompanied with actual danger, man himself begins to partake in the general dread, and amidst this play of celestial artillery, he often feels for the first time the true rank which he holds in the scale of being. These tremendous phenomena often make the circuit of the whole horizon, and are frequently interrupted by heavy showers of rain or hail, till the atmosphere resumes its wonted serenity.

The lesser phenomena which appear in a storm, do not merit any particular description. The flashes of lightning sometimes appear on an angular or zigzag form, and are then called forked lightning. At other times, particularly when it strikes the earth, there is the appearance of a dense globe of fire; and at other times it is a sudden and universal flash, which has received the name of sheet lightning. The sheet lightning is most frequently seen in fine summer evenings, and is on these occasions never accompanied with thunder. The colour of lightning is sometimes of various shades of blue, at other times of a vivid yellow colour, and at other times of a pale straw colour; and it is probable, that the nature and intensity of its colour depends on the nature and density of the stratum of air which it traverses.

The noise of the thunder, which in general follows the flash of lightning, has various characters, depending on the situation of the person who hears it, and probably on the state of the clouds in which it is produced. Sometimes it resembles a sudden crash, like the sound of a piece of artillery, which is not repeated or prolonged by reflection. Sometimes the noise is rumbling and irregular, like the prolonged and dying echoes of a pistol when discharged in a mountainous country; and at other times it resembles the series of sounds, which are produced by the successive discharge of a great number of muskets. The first of these sounds generally takes place when the thunder is near, and the second is generally the character of distant thunder. The distance of the thunder stroke may be easily computed, by multiplying 1142 by the number of seconds which elapse between the flash and the thunder; the product is the number of feet at which the stroke has taken place.

In the preceding observations, we have spoken only of that kind of lightning which either flashes from cloud to cloud, or descends in a thunder bolt to the earth, destroying every non-conducting body that resists its passage. Another kind of thunderbolt, however, has been observed, which rises from the earth, and has therefore received the name of the ascending thunderbolt. This species of thunder appears to have been observed by the ancients; and the Tuscanians have even divided thunder into two kinds, viz. celestial and terrestrial, or that which falls from the clouds and that which rises from the earth. The first modern writer who noticed this species of thunderbolt was the Marquis de Maffei, who wrote a letter on the subject on the 10th Sept. 1713 to M. Vallisnieri, professor in the university of Padua. When living at the chateau of Foslinovo, situated on a mountain, he observed in the time of a storm the lightning issue from the ground, attended with a loud noise. The Abbé Jerome Lioni di Ceneda† witnessed the very same phenomenon in a violent storm. A brilliant flame rose rapidly from the earth to the height of two yards, and disappeared with a loud noise.

George Frederick Richter‡ relates, that in the cellar of the Benedictines of Potigno, when the servants were pouring into a cask some wine which had been boiled, a light flame shone round the funnel, and the operation was scarcely finished, when a frightful noise, similar to that of loud thunder, was heard. The cellar was filled with fire, the bottom of the cask was found pierced

† "Subito ascendit flamman vividaissimam conspecto, duos paulo minus subito supra terram tenue traecus ascendens, et etiam quam paro evanescens, relicto terribilissima fragore." Journal de Venise, tom. xxxii. art. 8. § 41.
‡ Richter De nativibus fulminum tractatus physicus. Leips. 1725.
with a hole three inches in diameter, the staves were broken, and in spite of the iron hoops which retained them, they were dashed with violence against the walls. In 1725, M. Seguier of Nismes, when he was at a country house about a league from the town, observed during a thunderstorm the lightning to rise from the houses in the form of a flame about 6 feet wide. This phenomenon soon disappeared, and was followed by a loud clap of thunder. Similar phenomena have been noticed and described by many distinguished philosophers, so that there can be no doubt that lightning often rises both from the surface of the earth and from the surface of water in the time of thunder storms. The Abbé Bertholon has collected, with great care, numerous examples of this phenomenon, but we can only find room for the references to the works in which they are contained.

The Marquis Maffei and several other authors have concluded from the preceding facts, that lightning has its origin in the earth, and always ascends into the atmosphere. This conclusion, however, is obviously too general, and is directly opposed by facts more numerous than those which are brought to support it.

Having thus described the general phenomena which accompany a storm of thunder and lightning, we shall conclude this Section by an account of some electrical appearances, of a very singular character, which have been observed by individuals when overtaen by thunder storms on the tops of lofty mountains.

In the year 1767, M. de Saussure, M. Pictet, and M. Jalabert ascended to Mont Breven, which is situated nearly in the middle of the valley of Chamouni, and almost exactly opposite to Mont Blanc. Their object was to take a general view of the form and position of the glaciers which descend from this celebrated mountain. When they reached the summit, M. Jalabert began to take a drawing of the glaciers, M. Pictet was engaged in the geographical part, and M. de Saussure was preparing to make his experiments on natural and artificial electricity. When M. Pictet was laying down upon his plan some particular mountains by means of a graphometer, he had occasion to ask the names of them from the guides, and was therefore obliged to point out the individual mountains with his finger. Every time that he raised his hand for that purpose, he felt at the extremity of his finger a kind of tremulous and prickly sensation, similar to that which is experienced upon presenting the finger to a globe of glass highly electrified. M. Pictet soon perceived the origin of this phenomenon. He observed a stormy cloud in the middle region of Mont Blanc, directly opposite to Mont Breven, and it instantly occurred to him that he had been affected with the electricity of the cloud. He then requested M. de Saussure and Jalabert to repeat the experiment, and as soon as they extended their hands, they experienced the same sensation, which they described as resembling a number of small electric sparks; but fearing that they might be seduced by their imagination, they made their guides and their servants stretch out their hand, and they felt the same sensation. The electricity of the atmosphere having now begun to increase, the sensation became stronger, and was even accompanied with a kind of whistling noise. M. Jalabert, who had a gold band upon his hat, was alarmed with a buzzing noise about his head, and having taken off his hat, and put it successively upon the heads of Pictet and Saussure, they heard distinctly the same sound, and even obtained sparks from the golden button of the hat. The thunder cloud had now moved across the valley, and was directly above their heads. The thunder was loud, and the flashes of lightning so frequent, that the travellers found it prudent to descend about 20 or 30 yards, where no electricity could be perceived. The guides, however, were so much delighted with the experiments, that it was with great difficulty they were persuaded to abandon such a dangerous amusement. A shower of rain soon afterwards fell, and the storm ceased. The travellers reascended to the summit, and although they elevated an electric kite, they were unable to perceive any indications of electricity in the atmosphere.

A series of electrical phenomena, very similar to those which we have now described, were recently observed by a party of Englishmen, when they were descending Mount Etna, during a storm of thunder and lightning. I have been indebted for the particulars of the following account of them to my friend Dr Gordon, to whom it was communicated through the medium of a letter to Dr Moncrieff, by Mr Gillies, surgeon to his majesty's ship Partridge. This gentleman not only read a detail of the phenomena in a Sicilian journal, entitled Specchio della scienza e Giornale Encyclopedic de Sicilia, which was published in July 1814, but received an account of them from Mr Tupper, one of the party, coinciding in every respect with that which was given in the Sicilian Journal. On the 2d of June 1814, Mr Tupper and Mr Lanfear, accompanied by a guide, ascended Mount Etna. During their descent, when they were at a little distance from the place called the English House in the regio deserta, they were over taken with a storm of thunder and lighting, accompanied with a heavy fall of snow; and while running over an extensive field of snow, they were struck by a flash of lightning, from which, however, they experienced no serious injury. Mr Tupper felt a painful sensation in his back, which gradually ascended towards his head, and occasioned a sensation as if his hair was moving, an effect exactly similar to that which is produced either when a person is electrified upon an insulated support, or when his head is presented to the prime conductor of an electrifying machine. This sensation induced Mr Tupper to raise his hand to his head, upon which he was surprised to hear a buzzing noise proceeding from his finger. Upon raising and extending his arm the noise still continued, but upon moving his hand and fingers in different directions, and with different degrees of velocity, he found that he could produce, at pleasure, a great variety of musical sounds, differing in their tone as well as in their intensity, and so loud that they could be distinctly heard at the distance of 40 feet. The Sicilian guide witnessed these phenomena with extreme dismay, and imagining that Mr Tupper produced the sounds in virtue of some supernatural power, he immediately began to cross himself, and invoke the protection of his saint. His alarm, however, speedily subsided, when, upon being desired to elevate his own arm, he found it as musical as that of Mr Tupper. Mr Lanfear, who was a little behind the rest of the party, now joined them, and found that his fingers possessed a similar property. In the course of five minutes, reckoning, we presume, from the arrival of Mr Lanfear, their fingers lost their acoustic property, the cloud having by this time passed to a considerable distance. Mr Tupper had received an injury in his left shoulder joint by a fall from his horse, but he never afterwards experienced any return of the pain after the copious electrification which he received upon Mount Etna.
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The preceding phenomena admit of a ready explanation, upon the simplest principles of electricity. As snow is a conductor next in order to water, and very little inferior to it in its power of transmitting electricity, it is quite obvious that the bodies of the travellers were not overcharged with the electric fluid in consequence of any difficulty which they experienced in passing into the earth. Their fingers therefore acted like so many points in drawing electricity from an atmosphere highly charged, just in the same manner as when the hand or the head is presented to an electrified prime conductor. The variety in the character, as well as in the intensity, of the sounds which were produced at the points of their fingers, arose from the different velocities of their fingers, and may be readily imitated by any other species of sound. The buzzing noise which M. Jalabert heard round his head had a different origin, having been produced by the discharge of the electric matter which had been accumulated in the gold band, and which found a ready escape into the atmosphere by the numerous points of gold thread, than by the imperfect conducting power of the hat which it encircled.

For further information on the subject of this Section, see Nollet's Leçons de Physique, tom. iv. p. 34; Paccard in Saussure's Voyages dans les Alpes, tom. iii. p. 79. Note; Franklin's Letters, p. 44; Romas, Memoires des Savans Etrangers, tom. ii. p. 593; tom. iv. p. 514; Bécarar; Lettre de l'Électricisme; Cassini, Hist. Acad. Par. 1752, p. 10; Canton, Phil. Trans. 47; Devis, Id.; La Gardi, Journal des Savans, 1753, Oct. p. 228; Verrat, Comment. Bonnienius, tom. iii. p. 200; Muschenbroek, tom. 1. p. 397; Lamanon, Phil. Trans., vol. xlvii. p. 272; Gallitzin, Observations sur l'Électricité Naturelle par le moyen d'un ceint-électrique; Bertholom, De l'Électricité des Meteors, tom. i. p. 66.


3. On the Electricity exhibited in the production of luminous Meteors.

The Aurora borealis is undeniably the most magnificent of all the luminous meteors, which appear to be produced by the agency of electricity. In our article on that subject, (See Aurora Borealis,) we have already given an account of the various theories which have been brought forward to explain this remarkable appearance, and have pointed out its connection with the phenomena of electricity. Almost every philosopher, indeed, has adopted this opinion, and all the theories of the aurora borealis, with the exception of that of Monge, have called in the aid of electricity, either as a primary or a secondary agent. In the theory of M. Libes, for example, he supposes that a mixture of azote and hydrogen is inflamed by the action of the electric spark; and M. Dalton, who considers the aurora borealis as a magnetic phenomenon, still supposes that the light is produced by the transmission of the electric fluid.

Monge has ascribed the aurora borealis to the light of the sun as successively reflected from clouds placed at different distances in the heavens; but if this were the case, it is obvious that the light thus reflected would be either wholly or partly polarised, and if the light were not incident on the clouds at the polarising angle, the polarisation would still be effected by the number of reflections which it undergoes. Dr Brewster, however, has shown, from immediate observation, that the light of the aurora borealis has none of the properties of reflected light, and must therefore be direct light generated in our own atmosphere.

Mr Ronayne, Mr Cavallo, and some other authors, have often observed the state of the air during an aurora borealis, with electrical kites and thunder rods, but they were not able to procure any indication of electricity. On the other hand, a hissing and crackling noise has been heard by Mr Nairne and by Mr Cavallo, and Canton and Volta have obtained unusual degrees of electricity during the prevalence of this meteor. It must be remarked, however, that neither the existence nor non-existence of an unusual degree of electricity in the atmosphere, during an aurora borealis, could be considered as an argument, either against or in favour of its electrical origin; for it will appear, from the following Table, that the phenomenon takes place at such a height above the surface of the earth, that the regions in which it is formed might be highly charged with electric matter without imparting it in an unusual degree to the lower strata of the atmosphere.

In our article AURORA BOREALIS we have mentioned the method of imitating that phenomenon by electrical experiments. But the following experiment, conceived by the Abbé Bertholom, affords the best representation of the luminous columns by which the northern lights are generally distinguished. Let RR, Plate CCXLVI. Fig. 4. be the receiver of an air pump, and let a rod TT be screwed into a hole E, in a crescent of metal CD, whose lower surface consists of a number of angular projections; let a circular segment SS, of metal, having corresponding angular projections, be placed on the plate of the air pump, with the receiver being exhausted, and the metallic shoulder A is electrified, the whole of the receiver will be filled with a superb light, and columns of fire will dart from the angular projections in the crescent, to those of the plate SS.

The following Table contains the height of the aurora borealis at various times, and according to different observers. Excepting two or three numbers, the Table is taken from Bergman.

### TABLE shewing the heights of the Aurora Borealis.

<table>
<thead>
<tr>
<th>Date</th>
<th>Place where the Observations were made</th>
<th>Name of the Observers</th>
<th>Height in English Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1621. 12th Sept.</td>
<td>Peirier</td>
<td>Gassendi</td>
<td>556</td>
</tr>
<tr>
<td>1726. 19th Oct.</td>
<td>Rome</td>
<td>Bianchini</td>
<td>514</td>
</tr>
<tr>
<td>1730. 15th Feb.</td>
<td>Copenhagen</td>
<td>Kraft</td>
<td>440</td>
</tr>
<tr>
<td>16th March</td>
<td>Montpellier</td>
<td>Kraft</td>
<td>133</td>
</tr>
<tr>
<td>6th Sept.</td>
<td>Petersburgh</td>
<td>Kraft</td>
<td>160</td>
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<td>Geneva</td>
<td>Cramer</td>
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<tr>
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<td>Horrebow</td>
<td>686</td>
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<tr>
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<td>Breuilie</td>
<td>De Mairan</td>
<td>590</td>
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<tr>
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<td>Buache</td>
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<td>Godin</td>
<td>454</td>
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<td>De Fouchy</td>
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<td>Havre de Grace</td>
<td>De Mairan</td>
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<td>Paris</td>
<td>D'Arquier</td>
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<td>1763. 24th Oct.</td>
<td>Louvain</td>
<td>Bergman</td>
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<td>Louvain</td>
<td>Gisler</td>
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<td>1770. 22d Feb.</td>
<td>London</td>
<td>Piscator</td>
<td>254</td>
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<tr>
<td>1793. 15th Feb.</td>
<td>Kendal</td>
<td>Cavendish</td>
<td>62</td>
</tr>
<tr>
<td>1793. 15th Feb.</td>
<td>Keswick</td>
<td>Dalton</td>
<td>105</td>
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The other luminous meteors, which have been considered as electrical, are fire balls or globes of fire, shooting stars, and the fire of St Elm. Fire balls are less frequent than other meteors, and generally consist of large globes of fire advancing with a progressive motion. The fire ball which appeared on the 17th July 1771, was seen by a great number of philosophers in various parts of England and France. It appeared to be about a foot in diameter, or larger than the full moon, and had a progressive motion from north-west to south-east. The light, which was very intense, lasted only a few seconds, and two minutes after it had.
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Another species of meteors, called falling or shooting stars, are of very frequent occurrence. They have been observed at all seasons of the year, and during ev ery kind of weather; but they certainly occur most frequently at the season when the aurora borealis is visible, and are always seen in a lower region of the atmosphere. Mr Singer has counted no fewer than 80 of them in a single hour, and sometimes nearly twice that number.

The fire of St Elm, or Castor and Pollux, as it has been called, is a bright light, which often appears at the tops of ship masts, on the points of bayonets, and on the summits of spires. This phenomenon is obviously nothing more than the electricity of the atmosphere discharging itself into the earth by a pointed body elevated in the air.

Several authors have employed the electric fluid, for the purpose of accounting for volc anoes, earthquakes, fog s, and wa ter-spouts; but no facts have yet been established, which entitle us to consider these phenomena as of electrical origin. See Bergman, Opuscula, tom. v. p. 291. Dalton, Meteorological Essays. Ronayne, Phil. Trans. 1772, vol. lxii. Cavallo's Electricity, vol. ii.; Cavallo's Natural Philosophy, tom. iv. p. 559. Bertholot, De l'Electricité des Meteores; tom. ii. and Singer's Elements of Electricity, p. 261. See Meteoric Stones.

CHAP. III.

On the Effects of Electricity.

SECT. I. On the Mechanical Effects of Electricity.

In the transmission of the electric fluid through bodies that have the power of conducting it with facility, its passage is not marked with any mechanical effect; but when electricity is accumulated to such a degree as to be capable of passing through a non-conducting substance, it experiences such a resistance in its passage, that it can only be overcome either by expanding or shattering the substance itself. It is thus that the accumulated electricity of the atmosphere is carried off in silence and safety when it strikes upon a rod of iron, while a beam of wood or a tree is shivered into a thousand fragments. The mechanical effects of electricity are exhibited in its power of impelling and dispersing light bodies, of perforating, expanding, compressing, tearing, and breaking to pieces, all conducting substances through which it is sufficiently powerful to force its passage.

Exp. 1. If a light wheel, having its vanes made of card paper, be made to turn freely upon a centre, it will be put in motion when it is presented to an electrified point. The wheel will always move from the electrified point, whether its electricity is positive or negative. In this experiment, the current seems to be produced by the recession of the similarly electrified air in contact with the point; and, therefore, the circumstance of the wheel turning in the same direction when the electricity is negative, cannot, as Mr Singer has remarked, be considered as any proof of the existence of a double current of the electric fluid.

Exp. 2. Having formed a groove, either by bending a piece of clean card paper, or by hollowing out a piece of baked wood, or by placing parallel to each other two straight sticks of sealing wax, lay the groove upon the plate of Henley's universal discharger, and place a large pith ball, about half an inch in diameter, so as to be at equal distances from the two brass knobs of the discharger. The distance of these knobs should be about four inches, and the groove placed on the line joining the knobs. If one of the wires is connected with the outside of a charged jar, while the knob of the jar is brought into contact with the other wire of the discharger, so that a small spark may pass from the one knob of the discharger to the other, the pith ball will be impelled from the positive to the negative knob; that is, to the knob which communicates with the negative side of the jar. Mr Singer recommends the use of points instead of the knobs employed by Cavallo; and he has shown, we think satisfactorily, that the transmission of the charge is prevented by the use of knobbled wires; and that the motion of the ball is, in that case, produced by attraction, whereas, with pointed wires, the effect is produced solely by a continued current of electricity.

Exp. 3. Place upon an insulating stem a light wheel of card paper, properly suspended upon pivots, as represented in Fig. 5. Plate CCXLVI. and introduce it between the pointed wires A B of the universal discharger, placed exactly opposite to each other, and at the distance of little more than an inch from the upper vanes. Then having connected the wire A with the positive conductor, and the wire B with the negative conductor of an electrical machine, the little wheel will revolve in the direction AB; and if the wire B is con-

* See Part II. of this article for a description of this ingenious instrument.
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Perforation of non-conducting bodies.

Exp. 4. Place a piece of card against the outside coating of a Leyden phial, and bring the lower knob of the discharging rod towards the outside coating, so that the thickness of the card is interposed between it and the tinfoil; then, when the jar is discharged by bringing the upper knob in contact with the knob of the jar, the charge will pass through the card and perforate it. On the side of the card, next the discharging rod, there will be a small burr or protrusion, and on the other side a larger bur. The holes in the card will be larger or smaller, according to the humidity or dryness of the card. A quire of paper, or the board of a book, may also be perforated by a great charge, and if the paper be freely suspended, it will be perforated without receiving the least motion, in the same manner as a ball will pass through an open door without turning it on its hinges. When this experiment was made by Mr Symmer, the paper was laid in a horizontal position, and he found that the ragged edges pointed mostly outwards from the body of the quire. When he turned over the leaves, however, he found that the edges of the holes were bent regularly in two different ways, and more remarkably so, about the middle of the quire, one part of each hole upwards, and the other part downwards, so that tracing any particular hole as it traversed the quire, he found that on one side the fibres pointed one way, and on the other side the other way, as if the hole had been made in the paper, by drawing through it two threads in opposite directions.

Mr Gough has lately shewn, that when the preceding experiment is accurately performed, the bur on the negative side is always the largest.

Exp. 5. Place in the middle of a paper book, about the thickness of a quire, a slip of tinfoil, and, in another paper book of the same thickness, place two other slips of the same kind of tinfoil, separated by the two middle leaves of the book. Let a strong charge be now made to pass through these two books in succession, and the following effects will be visible. In the first book, the paper leaves on each side of the tinfoil will be perforated, while the tinfoil itself is merely indented in opposite directions, and the burrs and the perforation will point different ways. In the second book, all the leaves of paper will be penetrated, excepting the two that are included between the slips of tinfoil, and in these two leaves there will be two impressions or indentations, in opposite directions.

Mr Symmer, who made the experiment in the presence of Dr Franklin, concluded from it, that there were two opposite currents of electricity arising from electric fluids, and the same conclusion has been drawn by Mr Ezekiel Walker. Mr Singer, however, has endeavoured to shew, that these effects are produced solely by an expansion of the paper.

Exp. 6. Take a small phial, or a glass tube sealed hermetically at one end, and fill it nearly with olive oil. Having put a cork into the phial or tube, introduce a wire through it, so that its sharp point may touch the inside of the phial or tube beneath the surface of the oil. Let the vessel be now suspended to the prime conductor of an electrifying machine, and the machine being worked, bring either the knuckle or a brass ball exactly opposite to the point of the wire within, so that a spark may pass between the wire and the knuckle, the passage of the electricity through the glass will perforate it completely. By bringing the wire in contact with different parts of the glass, a great number of holes may be made in it.

Exp. 7. Place the ends of the two wires at the distance of an inch from each other, and experiment under the receiver of an air pump, and, in proportion as the air is exhausted, the place of perforation will happen nearer the positive wire. When the air is half exhausted, the hole is precisely half way between the two wires. At every discharge, a flash passes from each conductor to the place of perforation. This experiment was confirmed by M. Trenerry.

Exp. 8. Make the preceding experiment under the receiver of a pump, and, in proportion as the air is exhausted, the place of perforation will happen nearer the positive wire. When the air is half exhausted, the hole is precisely half way between the two wires. At every discharge, a flash passes from each conductor to the place of perforation. This experiment was confirmed by M. Trenerry.

Exp. 9. Into a piece of soft tobacco-pipe clay, or any other kind which is neither too dry nor too moist, introduce two wires, so that their distance within the clay is not very great. Let a shock be passed through the wire, as already described, and it will be found that the clay is curiously expanded in the interval between the wires. If the clay is too dry, or the shock too strong, it will be shivered into innumerable fragments. If the clay is placed in the tube of a tobacco pipe, or in a glass tube, and if the shock is sent through it as before, the expansion of the clay will be so powerful as to shatter the tube which contains it.

In the course of his experiments on the effects of explosion through metallic substances, Dr Priestley observed, that a chain through which he had sent the charge of a battery was shorter than it was before. He then measured two feet four inches of the chain when it lay upon the table, and having sent through it a charge of 46 square feet of coated glass, it was shortened a quarter of an inch in its whole length.

Mr Nairne repeated the experiment with a piece of hard drawn iron wire 10 inches long, and 1/4th of an inch in diameter. He discharged 26 feet of coated glass nine times through the wire; after the sixth and

ninth time the wire was measured, and was found to be
shortened in the proportion of \(\frac{1}{4}\)th of an inch at each dis-
charge. The same battery was then discharged six times
more through the same wire, which continued to short-
ened in the same proportion, the total diminu-
tion of length being \(\frac{1}{4}\)th inch and \(\frac{3}{4}\)th of an
inch. It could not be found, by a pair of scales that
turned with less than \(\frac{3}{4}\)th of a grain, that there was any difference in its
weight. It appeared, however, to have increased in
thickness, and it is probable, that its contraction in
length was owing to successive expansions. Mr Nairne
also found, that a piece of copper wire plated with
silver, and of the same dimensions as the iron wire,
was shortened only \(\frac{1}{10}\)th of an inch by one charge of
26 feet of coated glass, which is only \(\frac{3}{4}\) of the effect
produced upon the iron wire.

Mr Brooke found, that a battery of nine bottles, ex-
posing 16 square feet of coated surface, when disch-
raged nine times through a piece of steel wire 12 inches
long, and \(\frac{3}{4}\)th of an inch thick, diminished its length
one inch and a half.

**Exp. 10.** If any other substance, inferior in conduct-
ing power to the metals, such as water, be placed in a
glass tube, and if a shock is sent through the wires as
formerly, the tube will be broken in pieces by the ex-
pansion of the water. The same result will be obtained
if a common drinking glass, filled with water, is need
instead of the tube.

Beccaria made this experiment with a drop of water
in the centre of a solid glass ball, and the ball was brok-
en in pieces. In the same way Mr Morgan has suc-
ceded in breaking green glass bottles filled with water,
when the distance of the wires, between which the
shock passed, exceeded two inches; and Mr Singer
has burst glass tubes half an inch thick in the sides
with a bar of the same size: Beccaria varied the ex-
periment in a very pretty manner, by constructing a small
mortal with a ball, and placing behind the ball a drop of
water, so as to be between the two wires which pas-
sed through the side of the mortar. The charge being
sent through the two wires, the drop of water was
expanded with such force, as to drive out the ball with
great velocity. By a drop of oil, M. Lullin of Geneva
projected the ball with still greater velocity.

**Exp. 11.** Into the mouth of a mortar of ivory with
a cavity an inch deep, and half an inch wide, fit a cork cap,
so as to shut up the aperture without much friction,
and having made the wires pass through the sides of
the mortar, a shock sent through the wires will sud-
denly expand the air, and drive out the cork with
considerable violence.

**Exp. 12.** Fill a capillary tube with mercury, and
make the charge pass through it by means of wires, as
formerly, and the expansion of the mercury will be suf-
ficient to burst the tube.

**Exp. 13.** If the charge of a jar is made to pass over
the surface of a piece of soft dough, the tract of the
fluid will be marked with a permanent depression.

**Exp. 14.** If a clean brass chain, dipped in melted
rosin, is laid upon paper, and if the charge of a battery
of 52 square feet is sent through it, the resinous coat-
ing will be driven off from every part of the chain which
will be left as clean as if no rosin had been upon it.

**Exp. 15.** If the brass chain is laid upon a piece of
glass, and a similar charge passed through it, the glass
will be marked in a beautiful manner on every part of
its surface where it had been touched by the chain,
every spot having the width and colour of the link.

The metal could be scraped off the glass at the outside
of the marks, but in the middle part it was forced with-
in the pores of the glass.

Dr Priestley, to whom we are indebted for the two
preceding experiments, gave the same tinge to glass
with a silver chain, and small pieces of other metals,
but he could not obtain large pieces.

**Exp. 16.** Place a piece of dry writing paper upon
the table of Henley's discharger, and having taken off the
balls, place the ends of the wires against the paper, so
that the distance between the wires may be two inches.
If a powerful shock is now sent from one wire to the
other, the paper will be torn in pieces.

**Exp. 17.** In a piece of wood, half an inch long, and
a quarter of an inch thick, drill two holes at its oppo-
site ends, and insert the ends of two wires in the holes,
so that the points of the wires are at the distance of a
quarter of an inch. If a strong charge is now passed
through the wire, the wood will be split in pieces.

Stones, sugar, and other non-conducting and brittle sub-
stances, may be broken in a similar manner.

**Exp. 18.** Having placed a piece of plate glass, about
an inch square, and half an inch broad, upon the table
of Henley's discharger, and having pressed it (down
with a weight, set the points of the wires opposite to each
other, and against the under surface of the glass. If
the charge of a large jar is now sent through the wires,
the glass will be broken into innumerable fragments,
and some of it reduced even to an impalpable powder.
When the glass is very thick, so as to resist the effects
of the shock, it will be found marked with vivid priz-
matic colours, which, Mr Henley imagines, are produ-
ced by thin laminae of the glass separated from it by
the shock; but it is more probable that it is an oxidation.

**Exp. 19.** If a very large charged jar has its outside
coating connected with the outside coating of another
jar about ten times less, and if a communication is made
by the discharging rod with their inside coatings, the
small jar will be broken, from the great quantity of elec-
tricity which is suddenly transferred to it.

The curious experiments of Professor Lichtenberg
of Gottenburg, on the arrangement of powders upon an
electrified plate, may be given without much impro-
propriety under the present Section.

Let a plate of any resinous substance, as rosin, gum
lac, &c. be excited either by friction or otherwise,
and let any metallic body of any shape whatever, a brass
ring for example, be placed upon the plate. Let this
ring be then electrified with an electricity opposite to
that of the plate, and afterwards removed from the plate
by a stick of sealing-wax, or any other non-conducting
body. Let some powder of rosin, kept in a linen bag,
be now shaken upon the resinous plate, then if the plate
is excited negatively, and the brass ring positively, the
powder will fall only on those points of the plate that
were touched by the brass ring, and will form beauti-
fully radiating appearances like stars, while almost no
powder will be found on any other part of the plate.

If, on the other hand, the plate is electrified positively,
while the ring is electrified negatively, then the pow-
dered rosin will fall only on the parts of the plate which
were formerly uncovered, the figures of stars being now
indicated by the absence of the powder.

These experiments, which were first known in Eng-
lnd in 1771, were immediately repeated and varied by
the Rev. A. Bennet, and M. Cavallo. Mr Bennet has
given the following account of his method of rendering
these figures permanent. "To make red figures, take
a pound of rasped Brazil wood, put it into a kettle with
as much water as will cover it, or rather more; also put

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**Note:** The text contains a mix of historical and scientific observations related to electricity, including experiments involving glass, water, and metallic chains, as well as descriptions of the effects of electric discharges on various materials and structures.
In about an ounce of gum arabic, and a lump of alum about as big as a large nut; let it boil about two hours, or till the water is strongly coloured; strain off the extract into a broad dish, and set it in an iron oven, where it is to remain till all the water be evaporated, which with me was effected in about twelve hours; but this depends on the heat of the oven, which should not be so hot as to endanger its burning. Sometimes I have boiled the strained extract till it was considerably inspissated before it was placed in the oven, that it might be sooner dry.

When it is quite dry but not burnt, scrape it out of the dish, and grind it in a mortar till it be finely pulverized. In doing this, it is proper to cover the mortar with a cloth, leaving a hole through to prevent the powder from flying away and offending the nose, and also to do it out of doors if the weather be dry and calm, that the air may carry away the powder necessarily escaping, and which otherwise is very disagreeable. When ground fine, let it be sifted through a fine hair sieve, returning the coarser part into the mortar to be ground again. When the grinding and sifting are finished, the powder is ready for use. The resinous plate I have mostly used, was composed of five pounds of resin, half a pound of bees-wax, and two ounces of lamp-black, melted together, and poured upon a board sixteen inches square, with ribs upon the edges at least half an inch high, to confine the composition whilst fluid: thus the resinous plate was half an inch thick, which is better than a thinner plate, the figures being more distinct. After the composition is cold, it will be found covered with small blisters, which may be taken out by holding the plate before the fire till the surface be melted, then let it cool again, and upon holding it a second time to the fire, more blisters will appear; but by thus repeatedly heating and cooling the surface, it will at last become perfectly smooth. Some plates were made smaller, and the resinous composition confined to the form of an ellipse, a circle, or escutcheon, by a rim of tin half an inch broad; and fixed upon a board.

The next thing to be done is to prepare the paper, which is to be softened in water, either by laying the pieces upon each other in a vessel of cold water, or first pouring a little hot water upon the bottom of a large dish, then laying upon it a piece of paper, so that one edge of the paper may lie over the edge of the dish, to remain dry, that it may afterwards be more conveniently taken up. Then pour more hot water upon its upper surface. Upon this place another piece in the same manner, again pouring on more water, and thus proceed till all the pieces are laid in. By using hot water, the paper will be more softened in a few minutes than if it remains in cold water a whole day.

When the figures are to be made, the resinous plate must lie horizontally, whilst the electricity is communicated, if the experiment requires any thing to be placed upon the plate; but it is convenient afterwards to hang it up in a vertical position whilst the powder is projected, lest too much powder should fall where it is not required. A little of the powder may be taken between a finger and thumb, and projected by drawing it over a brush; or, what is better, a quantity of powder may be put into the bellows and blown towards the plate. When the figure is sufficiently covered with powder, let the plate be laid horizontally upon a table; then take one of the softened papers out of the water by its dry edge, and lay it carefully between the leaves of a book, pressing the book together, and let it lie in this situation about half a minute. Then remove the paper to a dry place in the book, and press it again about the same time, which will generally be sufficient to take off the superfluous moisture. Then take up the paper by the two corners of its dry edge, and place the wet edge a little beyond the figure on the resinous plate, lowering the rest of the piece gradually till it covers the figure without sliding; then lay over it a piece of clean dry paper, and press it gently; let it remain a short time, and then rub it closer to the plate with a cloth, or, which is better, press it down by means of a wooden roller covered with cloth, taking care that the paper be not moved from its first position. When the paper is sufficiently pressed, let it be taken up by its dry edge, and laid upon the surface of a vessel of water with the printed side downwards; by this means the superfluous powder will sink in the water, and the figure will not be so liable afterwards to spread in the paper. After the paper has remained on the water during a few minutes, take it up and place it between the leaves of a book, removing it frequently to a dry place. If it be desired that the paper should be speedily dry, let the book-leaves in which it is to be placed be previously warmed, and by removing it to several places it will be dry much sooner than by holding it near a fire, and without drawing the paper crooked.


Sect. II. On the Chemical effects of Electricity.

The effects of electricity as a powerful chemical agent, constitute one of the most interesting portions of the science. As these effects, however, are produced to a greater extent by the Galvanic apparatus, we shall have occasion to treat the subject at greater length under the article Galvanism. At present we shall confine ourselves to a few details respecting the action of the electric fluid in inflaming combustible bodies, in fusing and oxidizing metals, in promoting the combination and decomposition of different bodies, and in rendering them phosphorescent.

Exp. 1. Having placed warmed alcohol or ether in an insulated metallic cup, electrify the cup, draw a spark from the bottom of the cup either by the knuckle or any other conducting body, and the alcohol will be set on fire by the transmission of the spark.

Exp. 2. Place powdered rosin, or phosphorus, or camphor, on some cotton wool, and wrap it round one of the knobs of a discharging rod. Then having charged a Leyden jar, apply the naked knob to the external coating, and the covered knob to the ball of the phial, and the rosin, phosphorus, or camphor, will be set on fire by the discharge. Powdered rosin laid on the surface of water may also be inflamed by passing a charge over the surface of the water between two points.
ELECTRICITY.

Exp. 3. Into a clean wine glass well dried on the outside, and nearly full of water, pour a stratum of ether, which will of course lie upon the surface of the water. When the water is connected with the electrified conductor, and the knuckle presented to the surface of the ether, the spark which passes from the water to the knuckle will inflame the ether.

Exp. 4. Fix a small cartridge containing gunpowder upon a metallic wire, insulated at the extremity of a handle of glass or baked wood, and having presented the cartridge to the knob of a charged Leyden phial, the gunpowder will be exploded.

Exp. 5. In order to light a candle by electricity, thrust a wire up the middle of the candle to within a little distance of the wick, and having connected by a chain the outside coating of a charged Leyden jar with the lower extremity of the wire, bring the knob of the jar to the wick, and the candle will instantly be lighted. This experiment is represented in Plate CCXLVI, Fig. 6.

Exp. 6. In order to light a candle without a wire penetrating it, wrap some loose cotton over the end of a long brass pin or wire, and roll the cotton in some fine powdered resin. Having then charged a jar whose knob is bent outwards, so as to hang a little over the body of the phial, apply the naked extremity of the wire to the external coating, and the cotton end to the projecting knob, and the resin, and consequently the cotton, will be set on fire, and will burn long enough to light a candle. This experiment is by M. Ingenhouz, who recommends the use of the powder of white or yellow resin. If the cotton is dipped in oil of turpentine, the same effect will be produced by the aid of a larger jar; and it is singular, that the inflammation of the turpentine will be assisted by strewing upon it fine particles of brass dust.

The power of electricity in fusing metals was first observed by Dr Franklin, who placed thin pieces of them between two plates of glass bound fast together, and then passed an electric shock through them. The plates of glass were often shattered by the discharge; and when they remained unbroken, they were covered with metallic stains. A piece of gold leaf was thus driven into the pores of the glass, so as to be protected from the action of the strongest aqua regia. Fine gold made a reddish stain, and silver a greenish one. Mr Kinnersley, in the presence of Dr Franklin, exploded a case of bottles through a fine iron wire. The wire appeared at first red hot, and then fell into drops, which assumed a spherical form like small-shot. Mr Canton repeated this experiment, and found that with a case of 35 bottles, he could entirely destroy brass wire 1-330th of an inch in thickness. Beccaria succeeded in melting small stripes of metals, without placing them between panes of glass; and he imagined that all metals impressed the same colours upon a surface of glass. Dr Priestley having failed in repeating Mr Canton’s experiments, he inclosed the wire in small tubes of glass, and having sent through them the charge of a battery of 32 square feet, the wire was melted into globules of various sizes. He also inclosed his wires in paper; and on one occasion he melted an iron wire 1-70th of an inch in diameter with the same battery. Dr Priestley likewise succeeded in melting pieces of leaf brass, and driving them into the surface of the glass, so as to give them a metallic tinge. For this purpose he took three pieces of glass, and placed one of them on each side of that to which he proposed to communicate the tinge. A piece of leaf brass was then placed on each side of the middle plate. He then sent the charge of a battery through the two stripes of leaf brass, which projected a little over the glass plates. The upper and lower pieces of glass were shattered to pieces; but the middle piece being equally affected on both sides, remained unbroken, and had both its sides covered with a metallic tinge. These metallic colours have been employed to impress letters or ornaments on paper and silk. “The outline of the required figure,” says Mr Singer, “is first traced on thick drawing paper, and afterwards cut out in the manner of tinwell plates. The drawing paper is then placed on the silk or paper intended to be marked, a leaf of gold is laid upon it, and a card over that; the whole is then placed in a press or under a weight, and a charge from a battery sent through the gold leaf. The stain is confined by the interposition of the drawing paper to the limit of the design, and, in this way, a profile, a flower, or any other outline figure, may be very neatly impressed.”

The most accurate experiments on the fusion of metals by electricity have been made by Mr Brooke, Van Marum, Kienmayer, Mr Cuthbertson, and Mr Singer. The object of Mr Brooke was to determine the relation between the force of a battery and the quantity of wire which it was able to fuse. Mr Singer recommends as the best wire for experiments of this kind, the finest flattened steel wire sold at the watch-maker’s tool shops, by the name of watch pendulum wire. The circuit between the two coatings of the jar should be made as short as possible, and the wire should be placed in a straight line, and confined at the ends between small wire forceps. We have condensed the results obtained by Mr Brooke into the following Table. The two last experiments but one are by Mr Cuthbertson, and the last by Mr Singer.

<table>
<thead>
<tr>
<th>Brooke's experiments</th>
<th>Number of Bottles</th>
<th>Coated Surface</th>
<th>Grains of Repulsion in Brooke’s Electrometer</th>
<th>No. of Shocks</th>
<th>Length of Wire</th>
<th>Effect produced. Thickness of the Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9</td>
<td>16</td>
<td>32</td>
<td>12</td>
<td>12</td>
<td>Steel wire melted.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>16</td>
<td>32</td>
<td>1</td>
<td>12</td>
<td>Steel wire do.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>16</td>
<td>32</td>
<td>1</td>
<td>12</td>
<td>Brass wire do.</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>32</td>
<td></td>
<td>1</td>
<td>12</td>
<td>Steel wire do.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>16</td>
<td>32</td>
<td>1</td>
<td>12</td>
<td>Brass nearly melted.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>16</td>
<td>32</td>
<td>1</td>
<td>12</td>
<td>Steel melted.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>20</td>
<td>30</td>
<td>1</td>
<td>8 1/4</td>
<td>Brass nearly melted.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>20</td>
<td>30</td>
<td>1</td>
<td>8 1/4</td>
<td>Brass dispersed into smoke.</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>12</td>
<td>20</td>
<td>1</td>
<td>10</td>
<td>Steel wire made red hot.</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>20</td>
<td></td>
<td>2</td>
<td>10</td>
<td>Steel wire did not melt.</td>
</tr>
</tbody>
</table>
These experiments of Mr Brooke, and those which were made by Mr Cuthbertson, prove, that the action of electricity in wires increases in the ratio of the square of the increased power, since two jars charged to any degree will melt 4 times the length of wire that is melted by one jar, and this will be again quadrupled by doubling the height of the charge. Mr Singer has found this law accurate with moderate lengths of wire, and he observes, that it varies with the thickness of the jars employed. A large jar, for example, in his possession, which, from the extent of its coated surface, should melt 26 inches of wire with a charge of 30 grains, only melts 18 inches, which is a striking proof of the correctness of Mr Cavendish’s conclusion, that the quantity of electricity necessary to charge different coated jars of the same extent, is inversely as the thickness of the jars. The progressive effects produced upon iron and General steel wire, by increasing the charge which is sent through them, are very singular. With a low charge, the colour is first changed to yellow, then becomes blue by a higher charge, then red hot, then red hot and melted into balls; and if we increase the charge still farther, it becomes red hot and drops into balls, then disperses in a shower of balls, and lastly disappears with a bright flash, producing apparently a smoke, which turns out when collected to be a fine powder, consisting of the metal combined with oxygen, and weighing more than the metal which was fused. Singer’s Elem. of Elec. p. 180.

The experiments of Van Marum were conducted on Van Marum a greater scale than those which we have already mentioned. The following is a short summary of the principal results which he obtained.

### TABLE containing the Experiments of Van Marum on the Fusion of Metals.

<table>
<thead>
<tr>
<th>Metals</th>
<th>Square Feet of Coated Surface</th>
<th>Length of the Wire</th>
<th>Diameter in Parts of an Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>130</td>
<td>180 inches</td>
<td>1/10</td>
</tr>
<tr>
<td>Lead</td>
<td>225</td>
<td>120 inches</td>
<td>1/10</td>
</tr>
<tr>
<td>Tin</td>
<td>225</td>
<td>120 inches</td>
<td>1/10</td>
</tr>
<tr>
<td>Iron</td>
<td>225</td>
<td>5</td>
<td>1/10</td>
</tr>
<tr>
<td>Gold</td>
<td>225</td>
<td>4</td>
<td>1/10</td>
</tr>
<tr>
<td>Silver</td>
<td>225</td>
<td>3</td>
<td>1/10</td>
</tr>
<tr>
<td>Copper</td>
<td>225</td>
<td>4</td>
<td>1/10</td>
</tr>
<tr>
<td>Brass</td>
<td>225</td>
<td>4</td>
<td>1/10</td>
</tr>
</tbody>
</table>

When Van Marum transmitted a charge of 225 square feet through 50 feet of iron wire 1/24 of an inch in diameter, he found that the jars were not entirely discharged, and that the residuum was capable of melting two feet of the same wire. When the explosion was sent through 180 feet of the same wire, the residuum was discharged through 12 inches of the same wire, but it merely blued it.

Baron Kienmayer employed in his experiments the Kienmayer plate glass machine described by Ingenhousz, with his experiment a battery of 1/6 square feet of coated glass, and he obtained the following results, when the barometer was at
The effect of lightning in fusing metals is so familiar to every reader, that it is scarcely necessary to mention it. Money is often melted in the pockets of those struck with lightning; swords have been melted in their scabbards; and the leaden frames of church windows have been frequently fused. There is in the possession of Thomas Allan, Esq. of Edinburgh, a curious parcel of nails, which were struck with lightning on the road between Oxford and London. They have a very singular appearance, and are obviously expanded into twice their original diameter.

The power of electricity to oxidate metals, was observed by Bectaria and other electricians; but it is to Mr Cuthbertson that we are indebted for the most complete series of experiments upon this subject. The apparatus which he employed is represented in Plate CCXLVI. Fig. 7, and consists of a cylinder of glass ab, 8 inches high, and 2½ inches in diameter. On the lower brass cap b is screwed a stop-cock, and in the inside of the vessel is fixed a small roller, on which a quantity of wire, attached to a push-rod at intervals of 4 inches, is coiled. A brass tube a, about 3 inches long, is screwed into the centre of the upper cap b, and, by means of a long needle, the end of the push-rod and wire is thrust through it, and hog's lard is placed in the tube, so that the wire and push-thread may move through it air-tight. In this way the wire is extended in the centre of the glass cylinder, and when one length of it is exploded, another may be drawn forward by means of the contiguous push-thread without opening the cylinder. In order to ascertain the quantity of air absorbed during the process, a gauge, shown separately at A, about 10 inches long, and made of a glass tube, is screwed into the lower end of the stop-cock, and immersed in a vessel of quicksilver, the rise of which, when the stop-cock is opened, will be a measure of the air absorbed.

The air left in the receiver after a number of explosions, is always found to have been deprived of a portion of its oxygen; and if hydrogen or nitrogen be substituted in place of atmospheric air, the metal will not suffer any oxidation, but will be melted, and minutely divided.

The following Table contains the results of Mr Cuthbertson's experiments:

<table>
<thead>
<tr>
<th>Metals</th>
<th>Length of wire</th>
<th>Diameter of the Wires in parts of an inch</th>
<th>Number of grains with which Cuthbertson's Balance Electrometer was loaded.</th>
<th>Colour of the oxide when collected.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead wire</td>
<td>10</td>
<td>Σ</td>
<td>20</td>
<td>Light grey.</td>
</tr>
<tr>
<td>Tin wire</td>
<td>10</td>
<td>Σ</td>
<td>30</td>
<td>Nearly white.</td>
</tr>
<tr>
<td>Zinc wire</td>
<td>10</td>
<td>Σ</td>
<td>45</td>
<td>Reddish brown.</td>
</tr>
<tr>
<td>Iron wire</td>
<td>10</td>
<td>Σ</td>
<td>35</td>
<td>Purple brown.</td>
</tr>
<tr>
<td>Copper wire</td>
<td>10</td>
<td>Σ</td>
<td>35</td>
<td>Black.</td>
</tr>
<tr>
<td>Silver wire</td>
<td>10</td>
<td>Σ</td>
<td>40</td>
<td>Brownish-purple.</td>
</tr>
<tr>
<td>Gold wire</td>
<td>10</td>
<td>Σ</td>
<td>40</td>
<td>Brownish-purple.</td>
</tr>
</tbody>
</table>

In these experiments, Mr Cuthbertson employed very high charges, which is attended with great risk to the jars. Mr Singer repeated the experiments with shorter and finer wires, and with a moderate charge, and obtained the following results:

<table>
<thead>
<tr>
<th>Metals</th>
<th>Length of Wire</th>
<th>Diameter of the Wires in parts of an inch</th>
<th>Number of grains with which Cuthbertson's Balance Electrometer was loaded.</th>
<th>Colours of the Figures on Paper.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold wire</td>
<td>5</td>
<td>Σ</td>
<td>18</td>
<td>Purple and brown.</td>
</tr>
<tr>
<td>Silver wire</td>
<td>5</td>
<td>Σ</td>
<td>18</td>
<td>Grey, brown, and green.</td>
</tr>
<tr>
<td>Platinum wire</td>
<td>5</td>
<td>Σ</td>
<td>13</td>
<td>Grey and light brown.</td>
</tr>
<tr>
<td>Copper wire</td>
<td>5</td>
<td>Σ</td>
<td>12</td>
<td>Green, yellow, and brown.</td>
</tr>
<tr>
<td>Iron wire</td>
<td>5</td>
<td>Σ</td>
<td>12</td>
<td>Light brown.</td>
</tr>
<tr>
<td>Tin wire</td>
<td>5</td>
<td>Σ</td>
<td>11</td>
<td>Yellow and grey.</td>
</tr>
<tr>
<td>Zinc wire</td>
<td>5</td>
<td>Σ</td>
<td>17</td>
<td>Dark brown.</td>
</tr>
<tr>
<td>Lead wire</td>
<td>5</td>
<td>Σ</td>
<td>10</td>
<td>Brown and blue grey.</td>
</tr>
<tr>
<td>Brass wire</td>
<td>5</td>
<td>Σ</td>
<td>12</td>
<td>Purple and brown.</td>
</tr>
</tbody>
</table>

Mr Singer's experiments were not performed in receivers. The wires were stretched parallel to the surface of a sheet of paper, at the distance from it of ⅙ of an inch. When the explosion is made over glass, a part of the metal, in an unoxidated state, appears immediately under the wire, while the part of it which is oxidized produces around the other a figure of some width. In this case the figures are more beautiful, but less permanent than when they are impressed on paper. These experiments are generally made with high
of the Leyden jar being nearly one half. Dr. Pearson, who, after great labour, succeeded in decomposing water by electricity, made use of another method, which differs only from the preceding in the construction of the tube DE. Dr. Pearson fixed a glass tube DE, Plate CCXLVI. Fig. 9, or 5 inches long, and 4th or 5th of an inch in diameter, into the end of a brass tube EF, and placed the wire at the top D, as formerly described, making it extend to the brass tube, so as to be almost in contact with it, when the explosion is made. Care must be taken, however, to prevent the wire from touching the tube, for in this case no gas will be evolved. The tube being filled with water, and set in a cup of the same fluid, may be applied to the conductor, as already described; the insulated ball, however, must be placed at a greater distance from the prime conductor, and with a jar of only 50 inches of coated surface, gas will be produced in the brass tube at each discharge, in greater quantities, and with much less trouble than in the apparatus of the Dutch chemists, in consequence of there being no electricity left in the jar after each discharge.

Mr. Cuthbertson invented another very simple apparatus, shown in Plate CCXLVI. Fig. 10, where DE is a glass tube, 5 inches long, and half an inch wide, blown funnel-shaped at the end A. The other end has a wire ¼ of an inch thick sealed into it, as formerly described, and extending nearly to the bottom of the brass dish V, (generally within ¼ of an inch of it,) on which the tube rests. The coated surface of the jar requires to be about 150 inches, and the distance of the brass ball C from the conductor A was about ¼ th of an inch. From experiments made with these instruments, Dr. Pearson concluded, that the gas evolved from water consisted of oxygen and nitrogen, or azotic gas.

The apparatus for decomposing water was greatly simplified by Dr. Wollaston. This ingenious philosopher inserted two finely pointed wires, made either of gold or platinum, into capillary tubes. Each wire was introduced into the tube till it nearly reached the end of it, and the glass was softened by heat till it adhered to the point of the wire, and covered it. The glass was then gradually ground away, till the point of the wire could be seen through a magnifying lens. One of these wires communicating with the ground, or with the negative conductor of the machine, and the other with an insulated ball placed near the positive conductor, the two points were placed near each other in a vessel of water; when a current of sparks is discharged through the wires, a series of minute bubbles of gas rise from the points of the gold wires, and, when collected in an inverted receiver, they explode on the application of a lighted taper. Dr. Wollaston found by experiment, that a point ¼ th of an inch in diameter, decomposed the water when the spark which passed from the conductor to the insulated ball was ¼ th of an inch in length; and that a point ¼ th of an inch in diameter, produced a similar effect when the sparks were only ¼ th of an inch in length. Hence the rapidity of the decomposition was proportional to the limited size of the points of the wire. We are indebted also to Dr. Wollaston, for the following interesting experiments of Dr. Wollaston with the preceding apparatus. Having transposed a current of electric sparks, by means of two fine gold points, along the surface of a moistened card tinged with litmus, and placed between the points, a redness appeared about the positive wire after a few turns of the machine. By placing the negative wire upon the red spot, it was soon restored to its original...
blue colour. Hence it appears, that the positive effect of an acid is produced with wire, and that the opposite electricity counteracts this effect. Having coated two wires with sealing wax, so that the extremities only appeared, Dr Wollaston inserted them into a solution of copper, and, upon transmitting a current of sparks between the two wires, the negative wire was coated with copper. When the electricity of the wire was reversed, the coating of copper was immediately removed.

The agency of electricity, in combining and decomposing the gases, has presented chemistry with very interesting results. We are informed in Priestley’s experiments on air, that Mr Warltire fired a mixture of common and inflammable air by means of electricity, in a close copper vessel holding about three pints. A loss of weight, amounting at an average to two grains, was always perceived, although no air could escape by the explosion. When this experiment was repeated in glass vessels, clean and dry, the inside of the glass immediately became dewy. Mr Cavendish repeated these experiments in 1781. He exploded 500,000 grain measures of inflammable air with about 22 times that quantity of common air, and he, by this means, obtained 185 grains of pure water. Mr Cavendish then exploded a mixture of 19,500 grain measures of oxygen gas with 37,000 of hydrogen gas, and found that they were condensed into a liquor which weighed about 30 grains, which was sensibly acid to the taste, and which yielded two grains of nitre. By varying the proportions of the gases, he found, that as he increased the proportion of the hydrogen the acidity of the liquor was diminished, till, with certain proportions, the liquor differed in no respect from pure water. In the repetition of these experiments, Mr Cavendish confined the mixture of oxygen and hydrogen in a glass tube A, bent into an angle, as in Plate CCXLVI, Fig. 11; and which, after being filled with quicksilver, was inverted into two vessels of mercury. The gases were then introduced by a small thermometer tube, so as to occupy about one inch and a half in the angular part of the tube. He then connected the quicksilver in one of the glasses with an insulated ball, placed at a small distance from the prime conductor, while the quicksilver in the other glass communicated with the ground. Mr Cavendish found, that the experiment succeeded best when a mixture of five parts of oxygen with three parts of common air, was used instead of atmospheric air. He then introduced a little soap ley along with the air, and having sent through it a current of electric sparks, he continued adding more air as the air was diminished. The soap ley being then poured out of the tube, and separated from the quicksilver, were evaporated to dryness, and left a quantity of salt, which was evidently pure nitrate of potash. In consequence of several learned foreigners having failed in the repetition of this experiment, particularly Van Marum, Troostwyk, Lavoisier, Hassencratz, and Monge, Mr Cavendish wished to authenticate it in a public manner, and he therefore requested Mr Gilpin to repeat the experiment on the 6th of December 1787, before Sir Joseph Banks and the leading members of the Royal Society. The experiments were in every respect successful; and though there were some trifling differences in the proportions of the gases absorbed, yet he obtained the following average result, that seven measures of oxygen unite with nearly three measures of nitrogen to form nitric acid. Van Marum had written to Mr Cavendish, to learn the cause to which he attributed the failure of the continental philosophers in repeating this experiment. Mr Cavendish replied in a very handsome manner, and communicated to him every information on the subject. Van Marum, however, from some strange misconception, has represented Mr Cavendish, as having refused to comply with his request. Mr Cavendish has replied with great propriety to this charge, by publishing his own letter to Van Marum.

We cannot find room for any further details upon this subject; but the following Table, for which we are indebted to Mr Singer, will exhibit the principal results which have been obtained. When the mixture consists of inflammable gases and oxygen, the change is generally effected by a single spark; but in other cases, the current of sparks must frequently be continued for many hours.

TABLE, shewing the Results obtained by the explosion of mixed Gases by the Electric Spark.

<table>
<thead>
<tr>
<th>Names of the mixed Gases</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric air and hydrogen</td>
<td>Water and nitrogen.</td>
</tr>
<tr>
<td>Oxygen and hydrogen</td>
<td>Water.</td>
</tr>
<tr>
<td>Chlorine and hydrogen</td>
<td>Muriatic acid.</td>
</tr>
<tr>
<td>Muratic acid and oxygen</td>
<td>Chlorine.</td>
</tr>
<tr>
<td>Carbonic oxide and oxygen</td>
<td>Carbonic acid.</td>
</tr>
<tr>
<td>Nitrogen and oxygen</td>
<td>Nitric acid.</td>
</tr>
<tr>
<td>Sulphuric acid and oxygen</td>
<td>Sulphuric acid.</td>
</tr>
<tr>
<td>Phosphuretted hydrogen and oxygen</td>
<td>Water and phosphoric acid.</td>
</tr>
<tr>
<td>Sulphuretted hydrogen and oxygen</td>
<td>Water and sulphurous acid.</td>
</tr>
<tr>
<td>Oxygen and ammonia</td>
<td>Water and nitrogen.</td>
</tr>
<tr>
<td>100 Olefiant gas, and 284 oxygen</td>
<td>Carbonic acid and water.</td>
</tr>
<tr>
<td>100 Olefiant gas, and 100 oxygen</td>
<td>Carbonic oxide and hydrogen.</td>
</tr>
<tr>
<td>100 Carburetted hydrogen, and 100 oxygen</td>
<td>Carbonic oxide and hydrogen.</td>
</tr>
<tr>
<td>100 Carburetted hydrogen, and 200 oxygen</td>
<td>Carbonic acid.</td>
</tr>
</tbody>
</table>

The figures prefixed to the gases denote the proportional measures which were employed.

* Nitric acid is likewise produced if there is an excess of oxygen.
ELECTRICITY.

TABLE, shewing the Results obtained by exploding compound Gases.

<table>
<thead>
<tr>
<th>Names of the Compound Gases</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muriatic acid</td>
<td>Hydrogen. *</td>
</tr>
<tr>
<td>Fluoric acid</td>
<td>Hydrogen. *</td>
</tr>
<tr>
<td>Nitrous gas</td>
<td>Nitric acid and nitrogen.</td>
</tr>
<tr>
<td>Carbonic acid</td>
<td>Carbonic oxide and oxygen.</td>
</tr>
<tr>
<td>Sulphuretted hydrogen</td>
<td>Sulphur and hydrogen.</td>
</tr>
<tr>
<td>Phosphuretted hydrogen</td>
<td>Phosphorus and hydrogen.</td>
</tr>
<tr>
<td>Ammonia</td>
<td>Hydrogen and nitrogen.</td>
</tr>
<tr>
<td>Olefiant gas</td>
<td>Charcoal and hydrogen.</td>
</tr>
<tr>
<td>Carliuretted hydrogen</td>
<td>Charcoal and hydrogen.</td>
</tr>
</tbody>
</table>

The phosphorescent effects of electricity have been successively investigated by Mr Canton, Mr Lane, Mr Wilson, Mr Morgan, Mr W. Skrimshire, jun., and Mr Singer. Mr Skrimshire in particular has examined a great number of bodies, and has published the results which he obtained in the 15th, 16th, and 19th volumes of Nicholson’s Journal. He placed the substance to be examined on a brass plate, fixed horizontally on the knob of the prime conductor, by a thick piece of wire, and he endeavoured to take the spark from it by means of the ball of the discharger. It was afterwards placed upon a wooden stand, and the shock of a Leyden phial first passed over it, about a quarter of an inch above its surface, by resting the points of the discharging rods at the distance of an inch or more from each other upon the stone to be tried. In all the experiments it is necessary to close the eyes till the explosion be heard. In this way Mr Skrimshire obtained the following results:

TABLE, containing Mr Skrimshire’s Experiments on the Phosphorescent Effects of Electricity upon different Bodies.

Calcereous Genus.

| Experiments of Mr Skrimshire.                      |
|-------------------------------------------------|--------------------------------------|
| Calcereous spar                                  | Rendered very luminous by the shock. |
| Common chalk                                     | Very luminous when the shock passed above it. When passed along its surface, a zigzag track of light continued several minutes. Part of the stone shattered, and its luminous grains dispersed in all directions. |
| Ketton stone                                     | Shines for a few seconds with a vivid greenish light. |
| Selenite                                         | Gave small sparks, which were red flame-coloured upon its surface. |
| Fresh nitrate of lime                            | More phosphorescent than the nitrate of lime. |
| Muriate of lime                                  | Gave no sparks, but the electric fluid passed in a purple stream with a whizzing noise. |
| Dark purple fluor spar                           | Gave very good sparks, while dark purple fluor spar gave none. |
| Yellowish fluor spar                              | The most luminous of any substance by the electric explosion. |
| Sulphuret of lime, or Canton’s phosphorus        | A minute red spark. It is inflammable by a very small shock. |
| Phosphate of lime                                | Are rendered beautifully luminous, and give the prismatic colours. |
| Calcined oyster shells                           | Give a durable and bright light, according to Mr Singer. |
| Ditto calcined with sulphur                      |                                                   |

Barytic Genus.

| Experiments of Mr Skrimshire.                      |
|-------------------------------------------------|--------------------------------------|
| Carbonate of Barytes                             | No spark, but very luminous when the shock was passed above it. |
| Sulphate of Barytes                              | Good sparks, but slightly luminous. According to Singer, it gives a bright green light, more bright than that of the carbonate. |
| Sulphuret of Barytes                             | Was slightly luminous by the electric explosion. |

Muriatic Genus.

| Experiments of Mr Skrimshire.                      |
|-------------------------------------------------|--------------------------------------|
| Magnesia, pure and carbonated                    | Were both transiently luminous by the electric explosion. |
| Sulphate of magnesia                             | Very luminous throughout its whole substance. |
| Sulphuret of magnesia                            | Not more luminous than the carbonate. |
| Chlorite                                         | Sparks branching off in minute party-coloured points. |
| Steatites, tale, and fibrous amianthus           | Gave sparks, and were slightly luminous by the explosion. |
| Asbestus                                        | Ramifications on its surface more variegated than in chlorite. |
| Mica                                           | Affords sparks, but is not luminous by the explosion. |
| Micaceous schistus                               | Sparks ramified as in chlorite, scarcely phosphorescent. |

Argillaceous Genus.

| Experiments of Mr Skrimshire.                      |
|-------------------------------------------------|--------------------------------------|
| Alum                                            | Spark purple, rather ramified, luminous through its whole surface. |
| Pipe clay                                       | Sparks, and luminous, but not luminous when made into pipes. |

* These results are given on the authority of Dr Henry and Mr Dalton.
ELECTRICITY.

Sparks, and luminous, but loses its absorbent power as it becomes bituminous. (Singer; all phosphoric, (Skrimshire).)

Light, first red, and then white; a pale stream instead of a spark. (Singer.)

Phosphoric, with a dull white light; a purple stream instead of a spark.

Small purple spark. Not so luminous as quartz.

Aids very good sparks, and is luminous by the shock.

Luminous by the explosion, and gave hissing purple sparks.

Hissing purple sparks, and luminous by the shock.

Similar hissing sparks. Oval pebbles more luminous than the sand.

{Good sparks from the arborescent parts, but only a hissing stream from the stone itself, which is slightly luminous by the shock.

Hissing stream in some parts, and good sparks in others, slightly luminous.

} Neither give a spark nor are luminous.

Ditto.

Native carbonate of strontites.

Only a hissing purple stream, but very luminous by the explosion.

Combustibles.

Gives no spark, and is scarcely luminous by the shock.

Are not phosphoric.

Infames both by the spark and shock.

Some kinds afford good sparks, and are phosphoric, and some not.

Gives sparks, beautifully variegated, in minute spangles, radiated upon their surface; but they are not phosphoric.

Gives a very good spark, but is scarcely luminous.

Gives no sparks, but the fluid spreads uniformly and silently over its whole surface like the electric light in an exhausted receiver; it is luminous by the shock.

Is also luminous by the shock.

Give the same phenomena as bitumen, but are not luminous by the explosion.

Gives no sparks, but is phosphorescent, particularly fat amber.

Gives good sparks, and is not phosphoric.

Mr. Skrimshire was not able to discover any phosphorescent appearances, either in the metallic ores or oxides, or in the metals themselves.

M. Cavallo found, that the colours of vermillion, carmine, verdigrise, white and red lead, were altered by the electric shock; but that opaline, gamboge, sap green, red ink, ultramarine, Prussian blue, and a few other compounds of the above, were not altered.

We have avoided in the present Section giving any account of the brilliant electro-chemical researches of Sir Humphry Davy, as we propose to give a full account of his splendid discoveries in our article GALVANISM.


Sect. III. On the Magnetic Effects of Electricity.

In enumerating the points of resemblance between lightning and electricity, Dr. Franklin remarks, that they have both the power not only of reversing the poles of magnets, but of destroying the magnetism altogether. By transmitting a shock of four large jars through a fine sewing needle, he gave it such a degree of polarity that it readily traversed when laid on the surface of water. If the needle lay east or west when it was struck, the end Franklin's which was entered by the electric shock pointed north, and if it lay north and south, the end which lay towards the north continued to point towards the north, whether the shock entered at that end or at the other. He likewise found that the communicated polarity was strongest when the needle was struck lying north and south, and weakest when it lay east and west. In these expe-
ELECTRICITY.

Descriptive

Electricity.

Becaria's experiments.

Variation of the needle produced by electricity.

Compases destroyed by lightning.

Iron wires rendered magnetic by lightning.

Experiments of Van Marum.

riments, the needle was sometimes finely blued, like the spring of a watch.

Becaria repeated the experiments of Franklin, and found that lightning always gave polarity to the magnetic needle, and to all bodies, such as bricks, &c. that have any iron in their composition; and by observing the way in which these poles lie, he was thus enabled to ascertain the direction in which they were struck by the lightning. Hence he has conjectured, that a regular and constant circulation of the whole mass of the electric fluid from north to south may be the cause of magnetism in general.

Mr Benjamin Robins having had occasion to compare two compasses of a different make, one of them having a bare needle, and the other a chart like mariners' compasses, he accidentally wiped off with his finger some dust which lay upon the glass of the former, and was surprised to observe that the needle was thrown into a disorderly motion, partly horizontal and partly dipping. This disturbance he found to be owing to the electrical excitation of the glass by the slight friction which it received from his finger. By rubbing the glass with his finger, or with a bit of muslin or paper, either end of the needle was attracted by the part thus excited, and when the needle had for some time adhered to the glass, and afterwards dropped loose, its vibrations were not bisected, as usual, by that point where the needle should have rested. At the end of 15 minutes the electricity was generally dissipated, and the needle obeyed the magnetic force. By moistening the surface of the glass, or putting a wet finger upon it, the electricity could, at any time, be removed.

On the 9th of January 1749, the ship Dover, Captain Waddel, bound from New York to London, was struck and considerably damaged by lightning, in 'West Long. 29° 15', and North Lat. 47° 30'. There were four compasses in the ship, one of them in a brass box, and three in wooden boxes, and all of them were in good order before the storm. After the ship was struck with the lightning, however, Captain Waddel observed that all the needles had lost their virtue. The hanging compass in the cabin was not so much injured as the rest. The needles were at first nearly reversed, but after a little while they moved about in every direction, and were of no use. Mr Gowne Knight examined the compass, and observed that the outward case was joined together by pieces of iron wire, 16 of which were found in the sides of the box, and 10 in the bottom. Mr Knight applied a small needle to each of these wires, and found that the lightning had made them strongly magnetic, particularly those that had joined the sides.

If a steel wire is placed in a perpendicular direction, and a strong charge of electricity sent through it, it will be magnetized, and the lower end will be the north pole; if this end is now placed uppermost, and another charge passed through it, it will either destroy its magnetism altogether, or reverse its poles. The polarity of a natural magnet may also be destroyed, by transmitting through it a powerful shock.

The most accurate experiments, however, on the magnetic effects of electricity, were made by M. Van Marum with a battery of 135 jars, containing 130 square feet of coated surface, and with watch spring needles from 3 to 6 inches long, and also with steel bars 9 inches in length, between $\frac{1}{2}$ and $\frac{3}{4}$ an inch in breadth, and nearly a line in thickness. When the needle or bar was placed horizontally in the plane of the magnetic meridian, the north end of the bar acquired north polarity, and the south end south polarity, in whatever way the shock was communicated. When the bars had some degree of polarity before the shock, it was either diminished or reversed after it. When the needle or bar received the shock in a vertical position, its lowest end became the north pole, whether it was magnetic or not before the experiment. In general, the degree of magnetism which was communicated, was as strong in a horizontal as in a vertical position.

When the needle or bar was laid in the magnetic equator, it never acquired any magnetism in whatever way it received the shock, excepting when it was given through its width, and then the needle became considerably magnetic, the end which lay towards the west being the north pole, and the opposite end the south pole.

When the shock was so powerful as to make the needle hot, no perceptible magnetism was acquired.

When a magnetic bar, or a natural magnet, received the electric shock, its power was always diminished in whatever direction it was given.


Sect. IV. On the Effects of Electricity upon Animal Bodies.

When the effects of the electric shock were first exhibited, the most sanguine hopes were entertained that electricity would become a powerful agent in the cure of diseases. A fluid, indeed, so powerful and penetrating, which could be sent at pleasure through any part of the human body, and in any given quantity, might well be supposed capable of restoring to action and vigour the disordered functions of the animal frame; and had this investigation been left in the hands of those eminent men who were engaged in advancing the progress of electricity, science would never have been degraded by those gross impositions which have been practised upon the credulous.

We have already seen, in our History of Electricity, that several respectable individuals were for a while misled, by a number of absurd experiments said to have been made at Venice and Bologna. A diligent and careful inquiry, however, proved them to be false; and since that time, it has only been among a number of wandering enquirers, or among a few ignorant practitioners, that the panaceal power of the electric fluid has been acknowledged.

In these general remarks, we must not be understood as censuring, in the smallest degree, the cautious application of electricity, in some particular cases of disease. It were unphilosophical to maintain, that cures cannot be performed by this powerful agent; but the skilful and prudent physician will only admit its efficacy when he has seen it established by a cautious and impartial induction of well authenticated facts.

So late as the year 1785, there appeared a work by the Abbé Bertholon; entitled, De l'Electricité du corps humain dans l'état de Santé et de Maladie, in 2 vols 8vo. This work was crowned by the Academy of Sciences at Lyons, and its respectable author, who has cultivated, with assiduity, several branches of physics, was professor...
of natural philosophy to the States-general of Languedoc. In this work, electricity seems to be regarded as a power which has a most extensive influence in the cure of disease; and there is scarcely a class of maladies in which the Abbé Bertholon has not represented it as having proved successful. He has even gone so far as to maintain, that the electricity of the atmosphere has a principal share in the number of deaths, and particularly sudden deaths, and that it has a decided influence on generation, conception, and parturition.

Mr Carpeaux, in his Introduction to Electricity and Galvanism, has treated this subject with more caution. He has collected a number of cases in which electricity has been employed, and he has given the cases in which it was unsuccessful, as well as those in which it succeeded. Mr Singer has likewise enumerated several cases, in which the application of electricity has been beneficial; but from a careful examination of these cases, we should be disposed merely to conclude, that in rigidity, sprains, relaxations, indolent tumors, and chronic rheumatisms, the patient may reasonably expect, that he will either be relieved or cured by the agency of electricity.

Various facts have been published respecting the effect of electrical shocks upon animals in a state of health. Mr Morgan informs us, that if the diaphragm be brought into the circuit of a coated surface of two square feet, fully charged, the lungs will make a sudden effort, which is followed by a loud shout; but that if the charge is small, it always produces a violent fit of laughter, even upon persons of grave and solemn habits. The effect of a strong charge on the diaphragm is often followed by involuntary sighs and tears, and sometimes by a fainting fit. When a shock is sent through the spine of a person standing, he will often drop on his knees, or fall prostrate on the ground.

The effect of electricity in quickening the pulse was long ago maintained by M. de Bozes; and M. Nollet concluded from experiment, that it increased the sensible perspiration both of men and animals. In order to ascertain these points Dr Van Marum made the following experiments. In determining the effects of electricity on the pulse, he selected eleven persons, and repeated the experiments four times on each, both with positive and negative electricity. In order to prevent any effect being produced by the imagination, the persons were placed in a different room, that they did not know when the machine was in motion, or when it was at rest. The result was, that in some single cases a few beats more were observed, but, on the whole, there was no increase of any importance. In general, however, the pulse was very irregular, both when the machine was in motion, and when it was at rest.

For the purpose of examining the insensible perspiration of persons electrified, Van Marum employed a very sensible balance, one of whose scales was insulated by a silk cord. He placed a boy eight years old upon this scale, and having connected him with the conductor, he brought the balance into equilibrium. He then found that the boy lost 280 grains in half an hour before he was electrified, and 295 grains when he was electrified; but on another occasion he lost 320 grains before he was electrified, and 310 when he was electrified. A girl seven years old lost 180 before she was electrified, and 165 when she was electrified. A boy eight and a half years old lost 423 grains when unelectrified, and 290 when electrified. A boy nine years old lost 170 grains when unelectrified, and 216 when electrified. As this boy was very quiet during the experiment, the increase was attributed to electricity. The experiment was therefore repeated, and it was found that he lost 550 grains when unelectrified, and 590, 530, 270, 550, and 420 when electrified; hence it follows, that in most of the experiments there was a decrease rather than an increase of insensible perspiration.

According to Mr Cavendish, the sensible shock depends more on the quantity of electricity than on its force; a double force, with half the quantity, always producing a shock rather less powerful. Volta observes, that only a little more electricity is required to produce an equal shock from a larger surface. He found that a surface 16 times as large required an elevation of the electro-meter to one-tenth of the number of degrees. According to Dr IIlison, a small charge from a large surface gives a less unpleasant shock than a large charge of a small one, and may therefore be better fitted for medical purposes. He found likewise that the spark taken from a long wire is sharper than when it is taken from a large body.

In order to ascertain the cause of death in those struck with lightning, Dr Van Marum made a number of experiments on eels, which are well known to retain signs of irritability even when they are cut into three, four, or six parts, and when deprived of their head. The eels which he employed were a foot and a half long, and when the shock was sent through their whole body, they were instantly killed, and never afterwards moved; they were then skinned, pinched, and prickled, and salts and sparks were applied in vain to discover if any irritability remained. When the charge was sent through individual parts, such as the head, those only lost their irritability, while the rest retained it, and when the head was not affected with the shock, the remaining parts only were injured. The same results were obtained from eels three and a half feet long. When the shock was sent through the upper and fore part of the head of large eels, the under jaw, as well as the muscles of the neck and belly, and even the lower part of the body, preserved their irritability, while it was totally destroyed in the parts through which the charge was transmitted. The same results were obtained when the shocks of smaller batteries were sent through warm-blooded animals, such as rabbits. Hence, as the circulation of the blood can no longer take place when such a derangement is produced, this circumstance is unquestionably the cause of the sudden death of those who are struck by lightning. If the large arteries are not affected by the shock, the animal may still recover, provided the cerebellum and spinal marrow are not injured.

Various experiments have been made on the effects of electricity upon different animals; but, as the results are in no respects interesting, we shall content ourselves with a reference to the works in which they will be found.

The effects of electricity on the corruption of dead animals, has been examined by M. Achard of Berlin. Having divided a piece of raw beef into three parts, he...
ELECTRICITY.

On the Effects of Electricity upon Vegetables.

We have already stated the results of the experiments made by M. Maimbray of Edinburgh and the Abbé Nollet, on the effects produced upon the growth of vegetables by electricity. Similar experiments upon vegetables were repeated, with the same results; and the effect of electricity in promoting vegetation was universally acknowledged, till a complete set of experiments was made by Dr. Ingenhousz, who could not discover any foundation for the general opinion.

M. Jalabert, M. Boze, the Abbé Menon, Dr. Carmoy, the Abbé Dornay, and the Abbé Bertholon have, without much success, endeavoured to establish the opinion of the Abbé Nollet. The Abbé Bertholon, indeed, has written a work solely on this subject; and we were not surprised to find, that an author, who seriously maintained the influence of atmospheric electricity upon the generation of the human species, should support the more sober opinion, that it has a powerful effect upon the germination of plants. By means of an instrument called an electro-vegetometer, which is nothing more than a thunder-rod for bringing down the electricity of the atmosphere to the earth, he has proposed to convey electricity to particular spots, for the purpose of fertilizing the soil, and invigorating the health of tender plants. And when this celestial nourishment cannot be drawn in sufficient quantities from the clouds, he proposes to supply its place by a shower of electrified water. In order that our readers may judge for themselves of the advantages which are likely to be derived from these processes, we shall lay before them the following general remarks of the Abbé Bertholon.

"By means of the electro-vegetometer just now described, one may be able to accumulate at pleasure this wonderful fluid, however diffused in the regions above, and conduct it to the surface of the earth, in those seasons when it is either scantily supplied, or its quantity is insufficient for vegetation, or, although it may be in some degree sufficient, yet it can never produce the effects of a multiplied and highly increased vegetation. So that by these means we shall have an excellent vegetable manure or nourishment, brought down, as it were, from heaven, and that, too, at an easy expense; for, after the construction of this instrument, it will cost nothing to maintain it: it will be, moreover, the most efficacious you can employ; no other substance being so active, penetrating, or conducive to the germination, growth, multiplication, or reproduction of vegetables. This heavenly manure is that which nature employs over the whole habitable earth, not excepting even those regions which are esteemed barren, but which, however, are often fecundated by those agents which nature knows so well to employ to the most useful purposes. Perhaps there was nothing wanting to bring to a completion the useful discoveries that have been made in electricity, but to shew this so advantageous an art of employing electricity as a manure. Consequently, that all the effects which we have already mentioned depend upon electricity alone; and, lastly, that all these effects, viz. acceleration in the germination, the growth, and production of leaves, flowers, fruit, and their multiplication, &c., will be produced even at a time when secondary causes are against it; and all this is brought about by the electric fluid, which we have the art of accumulating over certain portions of the earth, where we want to raise those plants that are most calculated for our use.

"By multiplying these instruments, which are provided at little expense, (since iron rods, of the thickness of one's finger, and even less, are sufficient for the purpose), we multiply their beneficial effects, and extend their use ad infinitum.

"This apparatus having been raised with care in the midst of a garden, the happiest effects were perceived, viz. different plants, herbs, and fruits, in greater forwardness than usual, more multiplied, and of better quality. These facts are analogous to an observation which I have often made, viz. that plants grow fast, and are most vigorous, near thunder-rods, where their situation favours their development. They likewise serve to explain why vegetation is so vigorous in lofty
ELECTRICITY.

The various subjects to which we shall have occasion to direct the attention of the reader in the present Part of the article, may be arranged under five different heads:

I. On Instruments for collecting Electricity;
II. On Instruments for accumulating and discharging Electricity;
III. On Instruments for indicating and measuring Electricity;
IV. On Instruments for condensing, doubling, and multiplying Electricity; and
V. On Instruments for general Purposes.

BOOK I.

On Instruments for Collecting Electricity.

The instruments which have been employed for collecting electricity, are of three kinds: 1. The electrifying machine, for collecting the electricity produced by the excitation of electric bodies; 2. The Electrophorus, for collecting the electricity produced by the contact of dissimilar bodies; and, 3. Electrical Kites, Thunder rods, and Conductors, for collecting and discharging the electricity which exists in the atmosphere.

CHAP. I.

On the Electrifying Machine.

The electrifying machine consists of several parts: Of the electric substance, which is excited by motion; of the rubber by which it is excited; of the amalgam interposed between the rubber and the electric for increasing the excitation; of the mechanism for producing the friction; and of the prime conductor, for receiving the electricity as it is generated by the excitation of the electric.
The electrics which have been generally employed in the construction of electifying machines, are glass, sulphur, resin, gum, lac, dried wood, pasteboard impregnated with amber varnish, cloth, and catskin. The most useful and generally employed of all these substances, is glass, which, independent of its other qualities, is superior to all others, both in durability and in elegance. It has been employed sometimes in a rough state, but almost always in a polished state; sometimes it has been fashioned into the shape of a globe, at other times into a cylindrical form, and sometimes into a flat circular plate. When the glass is used in the form of a globe or cylinder, it has sometimes been found advantageous to line the inside of it to the thickness of a sixpence with a resinous composition, consisting of four parts of Venice turpentine, one part of rosin, and one of bees wax. This must be introduced in sufficient quantity into the inside of the globe or cylinder, and when the glass is brought gradually to an equal degree of heat throughout, the melted substance is allowed to spread itself over the interior surface, by turning the globe or cylinder about its axis. A coating is almost never used in modern electifying machines, but it has been found of great use in improving bad ones.

The human hand was the only rubber which was employed by electricians, till a cushion was introduced by Professor Winkler of Leipsic. The rubber consists of three parts; the cushion, the flap, and the stand. The cushion is commonly made of soft leather, generally basil skin, stuffed with flannel or hair, so as to be as hard as the bottom of a chair, and sufficiently soft to accommodate itself without much pressure to the surface of the globe or cylinder to which it is applied. In order to effect this, a spring is formed either upon the stand which supports the rubber, as in Plate CCXLIV, Figs. 1, 2, 3, 4, 5; or a spring is placed within the rubber, as in Fig. 10, which represents the rubber contrived by Mr. Jones. A piece of flexible iron or brass cd, is placed within the rubber AB, and keeps the surface A of the rubber in a state of uniform contact with the contiguous surface of the glass. The length of the cushion should be about 8 or 10 inches, and its breadth between 1/2 to 1 inches wide. The flap, which was introduced by Dr. Nooth, is a piece of thin oiled silk, of the same breadth as the length of the cushion, and nearly equal in length to the semicircumference of the cylinder. It should be sewed on the surface of the cushion about a quarter of an inch from its upper edge, so that the junction of the silk with the cushion may form a straight line rising a little above its surface. The flap should reach to within an inch in a row of metallic points at the extremity of the prime conductor, which we shall afterwards describe. This flap is not used when a globe of glass is employed. The rubber should be insulated upon a stand of glass, or baked wood.

The amalgam, which was first recommended by Canton, consisted of tin and mercury. Dr. Higgins recommended an amalgam of four parts of mercury and one of zinc. The common amalgam, however, which was for a long time used in England and on the continent, consisted of five parts of mercury and one of zinc, reduced to the consistency of butter, either by fusion or triturating; and mixed with a little chalk, or Spanish white, perfectly dry. The amalgam invented by Baron Kienmayer, consisted of mercury two parts, purified zinc one part, and pure tin one part. When the tin and zinc are intimately mixed by fusion, the mercury is added before they are cold, and the whole is shaken together in a wooden box. It is then poured out on a table of marble, and reduced to a fine powder in a mortar. Kienmayer found, that with the common amalgam he could charge a Leyden phial having 1/2 square feet of coated surface only with 10 revolutions; whereas with the preceding amalgam he required only 6. A battery, consisting of 58 square feet of coated surface, required 250 revolutions with the common amalgam, whereas with the new amalgam it required only 50 revolutions of the machine. In laying the amalgam on the cushion, he mixed it with a little hog's lard. Never's amalgam consists of equal parts of tin and mercury. Cuthbertson employed mercury with tin filings and a little oil. Cavallo recommended for the tin amalgam two parts of mercury and one of tinfoil, with a little powdered chalk; and for the zinc amalgam, four or five parts of mercury and one of zinc. When the zinc is melted, the mercury, heated to above the temperature of boiling water, must be added to it, and shaken in a wooden box. It must then be triturated with a little tallow, and a very little powdered whitening; and one-fourth of the amalgam must be afterwards added. Mr. Singer melts together one ounce of tin and two ounces of zinc, and when they are fluid he adds six ounces of mercury, and agitates the mixture in an iron or thick wooden box till it is cold. It is then triturated in a mortar, and formed into a paste by hog's lard. Mr. Singer is of opinion, that when amalgams have a large proportion of mercury, their action is variable and transient.

The friction of the electric is produced by turning it about its axis either with a simple winch, as in Mechanism Fig. 1. Plate CCXLI. or by a multiplying wheel, as in Fig. 2. For this purpose, the ends of the cylinder must be cemented into two pieces of well-baked wood, which rest upon two vertical supports, and were also for the pivots round which the cylinder is turned. The axis of the pivots must coincide exactly with the axis of the cylinder, so that the pressure of the rubber against the cylinder or globe may be uniform. The most common way of putting the cylinder in motion is by a simple winch or handle, as in Fig. 1. When a multiplying wheel is used, as in Fig. 2, the string is always becoming loose; and, though more electricity is produced in a shorter time, the labour of the operator is increased. When a glass globe is used, it is fixed only at one end, and is supported on a single stand, as in Fig. 4. The best electrical cement for attaching the cylinder to its pivots, is made by mixing five pounds of rosin, one pound of bees' wax, one pound of red ochre, and two table spoonfuls of plaster of Paris. The ochre and plaster of Paris should be well dried, and then added to and alternately mixed with the other ingredients, when they are in a state of fusion. This cement is recommended by Mr. Singer.

The prime conductor, or the positive conductor as it is sometimes called, was first applied by Professor Boze of Wittenberg. It is a cylindrical tube of thin sheet brass, or copper, or tin, or of pasteboard covered with gold-leaf or tinfoil, terminating in both ends with hemispherical caps, which can be taken off at pleasure. The conductor may be made solid as well as hollow; but this is altogether unnecessary, as we have already seen from Coulomb's experiments, that the electricity is merely distributed over the surface of conductors, and never penetrates the solid mass. Conductors are often made of solid wood, covered with tinfoil. The greatest care must be taken in the formation of the conductor, that its surface be entirely free of all points and asperities; and the holes which are made in it, of
the size of a quill, for the purpose of attaching wires and balls, and other pieces of apparatus, must have their edges well rounded and smoothed off. To the side or end of the conductor, according as its side or end is presented to the cylinder, is fixed a row of metallic points, which receive the electricity from the globe or cylinder, and which are placed at the distance of one-eighth or one-tenth of an inch from its surface. These points are seen in Figs. 1, 2, and 5, as placed at the extremity of the conductor. The length of the conductor is, in general, a little greater than that of the glass cylinder, and its diameter about ¾ of that of the cylinder. It must be insulated upon a glass stand, having its non-conducting power increased by a coating of sealing wax dissolved in spirits of wine, or the glass pillar may be heated, and then rubbed over with the wax. As gum lac is a better conductor than sealing wax, it might be substituted in its place. On the back of the rubber, as represented in Fig. 3, there is often fixed another conductor, called a negative conductor, and supported, along with the rubber itself, upon a varnished pillar of glass.

A necessary part of the electrical apparatus, is an insulating stool, which is nothing more than a piece of mahogany, or any other wood, supported upon 4 glass feet. Sometimes it is made large enough to hold a common chair, but, in general, it has only that size and strength which will allow a person to stand upon it with safety.

When the electrifying machine is about to be used, the greatest care must be taken to free it from all particles of dust, and to dry it thoroughly, by rubbing every part of the apparatus with a piece of flannel or woolen cloth made excessively dry, by being toasted before a good fire. The amalgam must be laid upon the cushion, and spread uniformly with a piece of leather, so as just to reach the junction of the silk glass with the cushion. If the machine has already been in use, the old amalgam should be carefully taken off; the silk flap should be freed from any dust, or amalgam that may have lodged upon its surface, and from the black spots and lines which almost always accumulate upon the cylinder or plate of glass, particularly after a recent application of the amalgam. Mr. Wolff, of Hanover, recommends strongly that a piece of fine white paper should be placed above the amalgam, so as to be interposed between the rubber and the glass. Mr. Nicholson has deduced, from a variety of trials, the following general directions for producing the most powerful effects from electrical machines. His directions refer to that kind of rubber in which the silk flap is attached to the lower edge of the cushion, and returns back over its surface. After the cylinder is cleaned, and the silk well wiped, grease the cylinder by turning it against a piece of leather containing the grease from a tallow candle. Continue to turn the cylinder till the silk flap has wiped off as much of the grease as to render the glass semi-transparent. Some of Higgins’s amalgam must be spread upon a piece of leather till it is uniformly bright. The leather must then be held against the turning cylinder. The friction will immediately increase, and the leather must not be taken away until the friction has reached its maximum. When these directions are implicitly followed, Mr. Nicholson found that the effect was extremely powerful. With a cylinder 7 inches in diameter, and a cushion 8 inches long, three brushes of light escaped at once from a 3 inch ball. A 9 inch cylinder, and an 8 inch cushion occasioned frequent flashes from the round end of a conductor 4 inches in diameter. With a 12 inch cylinder, and a rubber of 7½ inches, a 5 inch ball gave frequent flashes upwards of 15 inches long, and sometimes flashes were emitted from a 6 inch ball. The 7 inch cylinder afforded a spark of 10½ inches at the best, and the 9 inch cylinder, which had not a sufficiently high support, sent flashes to the table which was 14 inches distant.


SECT. I. On Electrifying Machines made of Globes and Cylinders of Glass.

1. Description of the common Cylindrical Electrifying Machine, with a simple Handle.

The common electrifying machine, consisting of a glass cylinder, was first introduced by the Germans, and notwithstanding the changes which it has undergone, it is still the cheapest, the simplest, and the most perfect of all the electrifying machines formed of glass.

This machine is represented in Plate CCXLVII, Fig. 1, where AB is the cylinder of glass, supported upon the two pillars E, E, made either of glass or baked wood. These pillars are firmly fixed into a board or stand GH, which is screwed to a table by means of the two clamps shown at X and Z. The cylinder of glass receives its rotatory motion, by means of the simple winch or handle W. The rubber is represented at m, supported on a pillar R, fastened into the board GH. By means of the screw S, this pillar can be brought towards S, so as to make the rubber m apply with sufficient tightness to the cylinder. The silk flap, attached to the rubber, is shown at n. The prime conductor CD is placed upon an insulating stand, and receives the electricity from the cylinder, by means of the metallic points shown at p. The jar and discharger, attached to the conductor, will be afterwards described.

2. Description of the common Electrifying Machine, with a Multiplying Wheel.

This machine is represented in Fig. 2, and is almost exactly the same as the last, excepting in the mechanism for giving the cylinder a rotatory motion. Instead of doing this by the simple winch W, as in Fig. 1, a small wheel w is fixed on the axis of the cylinder, which projects beyond the pillar F. Below this, and fastened to the pillar F, is a large wheel W, which has a motion of rotation round the fixed axis x, by means of the handle seen above H. A string being passed over the wheel, as shewn in the Figure, the revolution of the large wheel W will give a rapid motion to the small wheel w, and thus produce more electricity in a given time. Grooves of different diameters are cut around the wheels W and w, in order to tighten the string when it becomes loose by frequent use. In this drawing, we have shewn a different construction of the rubber; instead of being pressed against the cylinder by a screw S, as in Fig. 1, the pillar R is fixed into a slider, which can be pulled out and in, and tightened in any position by the screw nut N. The other letters in this Figure refer to the same parts as those described in the preceding article.


This machine, which is both simple, compact, and powerful, and has been much used for medical pur-
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PLATE CCXLVII.

Fig.

poses, as represented in Fig. 3, where AB is the glass cylinder, about 12 inches long and 7 inches in diameter, supported by the glass pillars E, E, and moved by the simple winch W. This machine is provided with two conductors, one of which D is the positive conductor, and the other C, the negative conductor, attached to the back of the rubber, which is not visible in the Figure. Both these conductors are hollow, and admit their ends to be taken off, so as to introduce a coated Leyden phial, which we have represented in the Figure at P as lying within the positive conductor D. Each of the conductors has a brass knob k, and is supported upon glass pillars R, S. These pillars are fixed at right angles to sliding pieces of wood, which move in grooves formed in the stand GH, and are kept tight in any position by the screw nuts N, N. One of these screw nuts keeps the rubber in contact with the cylinder, while the other gives stability to the positive conductor. The flap o a is seen extending over the cylinder from the negative conductor.

4. Description of Dr Priestley's Electrifying Machine.

As the electrical machine invented and used by Dr Priestley, was for a long time in great repute, and as it affords an example of a machine with a glass globe, we have given a drawing of it in Fig. 4. The glass globe AB is fixed upon the extremity of an axis at A, which passes through the upper part of the vertical stand EF, and carries a small wheel w. The rubber m consists of a hollow piece of copper covered with brass skin, and filled with horse hair. It is supported by a socket, which receives the cylindrical axis of a circular plate of glass f, the other end of which is fixed into a spring R, which is made to press the rubber against the globe by tightening the screw S. The prime conductor is a pear-shaped hollow vessel made of polished copper, and supported by a pillar inserted in a firm stand of baked wood. It is perforated with several holes for receiving hooks and wires. It receives its electricity from the globe, by means of a long arched wire CD, terminating in an open ring on which several sharp pointed wires are hung, so as to play lightly upon the globe when it is revolving. The globe is put in motion by a multiplying wheel W, turned by the handle seen above W, which, by the intervention of the string W w, drives the small wheel w, and thus gives any degree of velocity to the globe. When Dr Priestley wished to have positive electricity, he connected the rubber with the table or floor by means of the chain m n, and when he wanted negative electricity, he connected the rubber by a chain with an insulated conductor, and the conductor C with the table or ground. In the machine, as originally constructed by Dr Priestley, he made provision for receiving globes of different diameters, and also for using several at the same time, as well as for employing those of such a large size that they required support at both ends of their axis. Mr Lane's electrometer, in its earliest state, is represented as annexed to the machine at L. See Priestley's History of Electricity, p. 531.

5. Description of Read's Electrifying Machine.

This machine, though assuming a very different appearance from any of those which we have described, does not exhibit any essential improvements. It is, however, a convenient and compact machine, and has been very generally used. The cylinder AB is placed vertically, and has the upper extremity of its axis moveable in the end of the bent iron support EF. The rubber m is attached to an iron spring R, and is pressed against the cylinder by a screw S, but it has the disadvantage of not admitting of insulation. The cylinder receives its motion from the multiplying wheel W, and small wheel w, by means of a string. The conductor CD has a very peculiar form. It is opened and bent downwards at one end, so as to present a series of points p, p for receiving the electricity from the cylinder; and it is screwed into the head of a Leyden jar J, coated as usual. When it is not required to give a shock, the coated jar J is removed, and an uncoated jar put in its place, so as to serve merely for an insulating support for the conductor. Lane's electrometer is represented at L, as connected with the machine. See Priestley's History of Electricity, p. 529.


This machine, of which it is completely unnecessary to give a drawing, is interesting principally from its having been employed in the experiments of Beccaria. It consists of a cylinder turning horizontally between two upright supports, by means of a large multiplying wheel. This machine was supported upon a clumsy rectangular frame of wood, which rested upon four glass feet. Each of these glass feet was placed in semicircular boxes of tin, put together so as to form a circular box; and when the machine was in use, these tin boxes were filled with warm ashes, in order to produce a more perfect insulation, by keeping off all moisture from the glass. The prime conductor, which was suspended by silk strings, consisted of a cylinder of tin 12 feet long, and a foot in diameter, and had a conical end towards the cylinder of glass, the opposite end having a hemispherical form. The whole machine being insulated; positive electricity was obtained, by making a communication with the ground by means of a chain; and when negative electricity was wanted, the whole machine became a negative conductor, by making the positive conductor communicate with the ground.


This machine is chiefly intended for medical purposes, and for administering electricity in cases of suspended animation. It consists of a cylinder 74 inches long, and four inches in diameter, turned by a simple winch. Instead of a conductor of the common kind, it has a small insulated collector, which is a piece of smooth wood, covered with tinfoil, and rounded at the ends. It is about six inches long, and one inch in diameter, and collects the electricity from the cylinder by means of about twelve fixed pins of brass. It is then connected by a chain with a plate of glass 9 inches by 74, cemented to the head on the four corners of the box, by electrical cement, and coated on both sides with tinfoil, as in plate CCXLIII. Fig. 7. This plate serves for a Leyden phial. See Nicholson's Journal, vol. i. p. 506.

Various other machines, formed with globes and cylinders, have been employed by different experimental philosophers; but as they differ from those which we have described only in the awkwardness of their construction, it would be an insult to our readers to offer any particular drawing or description of them.

The original electrical machine used by Otto Guericke, was merely a globe of sulphur, of the size of an infant's head, formed by melting sulphur in a glass globe, and afterwards breaking the glass. It was then placed upon an iron axis, after being perforated in two places.
Light bodies were placed in the box below it, and when put in motion, it was rubbed by the hand till the light bodies were attracted by it.

Mr. Hawkesbee's machine was a glass globe turned by a large multiplying wheel, which whirled it round with great velocity. It had no conductor. Dr. Priestley has given a drawing of it in his History of Electricity.

The machine employed by the Abbé Nollet, of which a drawing is given by Dr. Priestley, differs in nothing but its frame from that of Hawkesbee. It was furnished, however, with a conductor, which was merely a bar of iron, or a gun barrel, and sometimes a chain suspended by a silken string coming from the ceiling of the room.

Mr. Wilson's machine consisted of a cylinder, turned with a multiplying wheel. Two horizontal silk cords were supported upon four vertical pillars of wood, and the conductor, which was a bar of iron, rested in an insulated state upon the silk cords. See a drawing of it in Priestley's History of Electricity.

Dr. Watson's electrifying machine consisted of four globes, supported in a vertical frame, and whirled round by four different strings placed in four different grooves on the surface of a large multiplying wheel. His prime conductor was a bar of iron suspended from the roof of the room. A drawing of it may be seen in Priestley's History of Electricity.

SECTION II. On Electrifying Machines made with circular Discs of Plate Glass.

There is one obvious disadvantage attending the construction of electrifying machines made of globes or cylinders, namely, the difficulty of cleaning their interior surface, in case of any moisture that may have accidentally introduced. In order to avoid this inconvenience, large cylinders have sometimes been constructed, so that the hand could be introduced at one end, for the purpose of cleaning and drying the globe. In order to avoid this evil, as well as to render the electrifying machine more portable and less liable to injury, a circular disc of plate glass was substituted in place of the glass cylinder. The honour of this invention has been claimed for our countryman Mr. Ramsden, and also by Dr. Ingenhousz, physician to the Emperor of Germany. Some persons have endeavoured to settle these claims, by asserting that the idea was conceived by Ingenhousz, and executed by Ramsden, and there is every reason to believe that this was the case. Dr. Ingenhousz proposed the use of a circular disc of glass in 1703, and mentioned the idea to Dr. Franklin and several other persons; and among the additions at the end of the first edition of Dr. Priestley's History of Optics, published in 1767, we are informed that Mr. Ramsden had recently executed a plate glass machine, which turned vertically, and was rubbed by four cushions, each 1 1/2 inches long, and placed at the opposite ends of the vertical diameter. See Phil. Trans. 1779, p. 659.

1. Description of the Plate Glass Machine.

A small machine of this kind, chiefly intended for medical purposes, is represented in Fig. 6 where AB is a circular disc of plate glass supported upon a horizontal axis, the two extremities of which rest on two upright pillars E, F. The plate receives its rotary motion from the simple winch W. The rubber consists of two pair of cushions, fixed at the opposite ends of a diameter of the circle, to pieces of mahogany m, m, so thin as to be considerably elastic. These cushions are seen more distinctly in the section of the machine given in Fig. 8, where they are marked by the numbers 1, 2, 3, 4. The cushions are kept tight against the plate of glass by means of the screws s, s. In this machine the conductor CD has a particular form, for the purpose of conveying the electricity to a jar placed as near as possible to the pillar F, in order to make the machine very compact. When the machine is not used for medical purposes, the conductor has the form represented in Fig. 9, where AB is the plate of glass, W the handle that turns it, and CDE the archd conductor, insulated by a pillar of glass R, and carrying two sets of points p, p for receiving the electricity from the machine. To each pair of rubbers is attached a flap made of oiled silk, one of them ascending and the other descending to the points p, p. These flaps are shaded darker than the glass. A discharging electrometer by Lane, is represented in Fig. 6, as inserted in the top of the jar.

2. Cuthbertson's Plate Glass Machine, with an insulated stand.

Mr. Cuthbertson, to whom the science of electricity is under great obligations, not only for many valuable additions to, and improvements upon, electrical apparatus, but for several excellent experiments, has brought the electrical plate machine to a state of very great perfection. As it is extremely difficult to insulate the rubbers of the plate machine without giving it a clumsy appearance, negative electricity may be obtained with equal ease, by insulating the whole machine, as in Fig. 8, where it is supported by four glass pillars G, H, I, K. In this construction, it is necessary to insulate the winch W by a glass rod. Instead of making the whole stand of one piece, as in Fig. 8, the machine may be fastened with clamps to a glass stool, of the same size and shape as the stand of the machine. The conductor, insulated by a rod of glass r, is shown at CD.


The double plate machine, as constructed by Mr. Cuthbertson, differs from the preceding only in having a greater interval between the two upright pillars E, F, for receiving two circular plates instead of one. The two plates are fixed parallel to each other, on the same axis, and are turned by the same handle. Two branches of the conductor are introduced between the two plates, and have rows of points on each side for carrying off the electricity from the glass. Hence it is necessary to support the conductor by an insulated stand separate from the machine, instead of placing it in a dovetailed groove, as is done in Fig. 8. In the machine made upon this principle by Mr. Cuthbertson for the Teylerian museum at Haarlem, each of the circular plates was five feet five inches in diameter, their distance 7 1/2 inches, and the length of the rubbers 15 1/2 inches. In order to strengthen the plates, and to prevent any dissipation of electricity along the axis, the two circular plates were coated with a resinous substance to the distance of 16 1/2 inches from the centre. The prime conductor consisted of several pieces, and was sustained by three pillars of glass 57 inches high. It was by means of this machine, which is celebrated in the history of electricity, that Van Marum made his experiments on the fusion of metals, of which we have given a full account.

The most perfect machine, perhaps, that has ever been constructed, is that which was made under the direction of Van Marum, and of which we have given a perspective view and a section, in Figures 1, 2, 3, 4, and 5. of Plate CCXLVIII. Great ingenuity is displayed in the construction of this machine, not only in preserving all its parts from a dissipation of electricity, but also in the method of obtaining positive and negative electricity at pleasure. The plate of glass AB, 31 inches in diameter, with all its apparatus, is supported upon a single column E, at the upper end of which are two brass collars I, I, each of which is shown separately in Fig. 4. On these collars rests the axis MN, which carries a counterpoise of lead L, to prevent too much friction on the collar 1 nearest the handle or winch W. The rubbers are shown at m, n, Fig. 1, being invisible in the section in Fig. 2. Each pair is supported on a horizontal position upon the plane glass pillars f, f, and is attached to balls O, P. The whole of this apparatus is minutely and correctly shown in Fig. 3, where O, P are the balls, and m, n the rubbers, with the glass plate moving between them. Receiving conductors C, D, each of which is six inches long, and two and a half in diameter, are fixed at the ends of the semicircle CGD, which is attached to an axis g, that turns on the ball G, so that the conductor CGD can be turned round into any position. A copper tube h H, terminating in a ball h, moves like a radius upon the stem of a ball h 2 inches in diameter, which is motioned by the rotation round I, so that it can be turned like the conductor CD into any position. Hence by this apparatus, the receiving conductor CGD can be brought either directly opposite to the rubbers m, n, or placed at right angles to them; and the receiving conductor CGD can be brought into contact with the rubbers m, n, while the conductors C, D, have a vertical position. By this ingenious contrivance, positive and negative electricity can be produced at pleasure, without any trouble. In the position represented in Fig. 1, the conductor G will give positive electricity, because the rubbers m, n communicate with the ground by means of the semicircular wire c d, and the vertical rod KK (Fig. 2.). But when negative electricity is wanted, the arc c d is moved into a vertical position away from the cushions, while the conductor CGD is moved into a horizontal position, so as to leave the receiving conductors C, D, opposite to the rubbers m, n. In order to prevent all dissipation or loss of electricity along the surface of the glass supports, a mahogany cap T covers the metallic caps, into which the supports are cemented. The lower extremity of the supports is likewise guarded by a hollow ring of mahogany; covering the metallic socket into which the support is inserted.

Fig. 5. is a section of the moving part of the branch c d.

Fig. 3. shews the method of constructing the rubbers, which have at their extremities four pieces of gum lac a, b, c, b.

From this brief description, our readers will be enabled to form a correct idea of the excellence of this ingenious machine; but for a minute account of all its parts, we must refer to the Journal de Physique for vol. viii. part ii.

5. Description of Wolff’s Electrifying Machine.

The machine used by M. Wolff, of Hanover, is nearly the same as that of Van Marum, which we have just described, but it differs from it essentially in the construction of the rubbers. The rubbers, which are 5½ inches long, 1½ broad, and ⅕ of an inch thick, are made of dry walnut wood, soaked in amber varnish. They are covered with a piece of thick woolen, on which is a piece of fine neat’s leather. When the leather is fastened to the wood, it is wetted, and pressed between two boards till it is dry. It is then covered with another piece of leather a little broader, having its rough surface towards the glass. A piece of silk is next applied accurately to this leather, after the silk has been heated and besmeared with butter of cacao, and a great quantity of Kienmayer’s amalgam. The leather is next covered with amber varnish. Amalgam is spread over this, and when the varnish is dry it is smoothed with a burnisher. This operation is repeated several times. When the rubber is very dry, and has been brought by pressure to touch the glass in all points, the leather, after being coated with amalgam, is covered with a piece of white paper of the same length as the leather, and about half an inch broad, so as to cover the seam by which the silk is joined to the leather. The paper is then fastened to the wood, above and below, according as it is on the ascending or descending side of the plate. A more minute account of this construction, and of the advantages which its author supposes it to possess, will be found in Gilbert’s Annalen der Physick, 1802, and Nicholson’s Journal, vol. vii. p. 124.

6. Description of Musnier’s Electrifying Machine.

This electrifying machine consists of a plate of glass moving vertically, and differs only from those of the common form in having the four cushions insulated upon pillars of glass, and connected with the upper ends of these pillars by semicircular springs. A drawing and description of the machine will be found in the Mem. Acad. Par. 1772, p. 502; and in Bertholon, De l’Électricité du corps humain, vol. ii. p. 220.

7. Description of St Julien’s Machine.

This machine consists of three plates of glass put in motion by a winch driving three-toothed wheels. The winch is fixed on one end of the axis of the largest wheel, and at the other end of the axis is fixed the middle plate of glass. Above and below this wheel is another wheel, upon the axis of which is a plate of glass, so that by turning the winch all the three plates are put in motion. Each plate is rubbed by four rubbers fixed to the upright supports, between which the plates move. The conductor is supported upon two glass rods, and the extremity of it nearest the machine has three arms like a fork, the plane of which is vertical. From the upper prong proceeds two long pointed wires, which receive the electricity from the upper plate of glass. From the middle prong proceed other two similar wires, which draw the fluid from the middle plate, and from the lower prong proceeds other two wires, to take the electricity from the lower plate. Each of the plates of glass is 15 inches in diameter; and the machine is said to have been much more powerful than a single plate machine thirty inches in diameter.
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3. Ingenhousz’s Portable Ribbon Machine.

This machine is nothing more than a varnished ribbon suspended upon a fixed pin or nail, and excited with a rubber of catskin. A small Lédon phial is held near the rubber, and collects negative electricity from the silk.


On account of the great expence of making a very powerful electrifying machine of plate glass, Dr Ingenhousz employed three pasteboard discs, four feet in diameter. Having soaked them in copal or amber varnish dissolved in linseed oil, he covered them with a thick coat of the same varnish, and dried them by the heat of a German stove. When the varnish had become very hard, he found that they were capable of a very powerful excitation by a rubber made of cat’s or hare skin. These discs were then placed in a frame, which was so constructed as to hold twelve of them. It consisted of two square pillars of wood, about five feet high and three inches broad, joined together above and below by a transverse piece of wood. In the middle of the two pillars was a hole about an inch and a half in diameter, made to receive a wooden axis. The pasteboard-discs were then put upon this axis, and between each two discs was placed a flat board, three inches broad, covered on both sides with flannel, and then with hare skin. The two square pillars were also covered with flannel and with hare skin. When the three discs were placed in the machine, Dr Ingenhousz received sparks about one and two feet long from the front surface of the first disc, by approaching his knuckle to it. He then applied a tin conductor, about six feet long, and six inches in diameter, divided into two branches, on the extremities of which was a thick silver lace fringe instead of points. Sparks, about four or five inches long, and extremely brilliant and strong, were received from this conductor. See Phil. Trans. 1779, vol. lxi. p. 659.

5. Electrifying Machines made of Wood.

M. P. Ammersin constructed electrifying machines made of a cylinder of wood, prepared by boiling it in linseed oil; and he obtained positive or negative electricity, according as he employed a rubber of silk or of wool. Professor Pickel at Wurtzburg, and Mr Kohlreif of St Petersburg, employed discs of well dried wood. Mr Kohlreif constructed a machine, in which he could substitute a plate of glass, or a plate of wood, according as he wished to have positive or negative electricity. The rubbers for the wooden plate were covered with fine fur from rats and mole.

6. Van Marum’s Machine consisting of Gum Lac and Mercury.

Van Marum constructed an electrifying machine that had a disc of gum lac, the inferior part of which was immersed in a vessel containing mercury, and was excited while in motion by the friction of the mercury. Van Marum found that the gum lac was much less affected than glass with the moisture of the atmosphere.


M. Lichtenberg constructed a machine which consisted principally of a drum or cylinder of wood covered with black woollen cloth. Above this cylinder he placed a cushion lined with catskin, which rubbed
against the woollen cylinder, and produced electricity in abundance. Beneath the drum he placed a pan containing burning charcoal, in order to keep the apparatus dry. Bohnenberger has constructed several machines upon this principle. Their principal recommendation is their cheapness and simplicity.

8. Dr Hamel's Electrifying Machine.

This machine, of which we have been favoured with an account by Dr Hamel of St Petersburg, is an improvement upon that of Lichtenberg. The cylinder of this machine is represented in section in Fig. 7; where A is its axis, and BC the cylinder, which is covered with wax taffetas. One end of the taffetas is fixed by silk strings, in two grooves on the circumference of the board B. The other end is lined with leather, along the edge of which are made a number of small holes, through which a silk string is conducted, and led round as many wooden pins, placed on the external surface of the board C, at some distance from the circumference. By this means the taffetas is stretched, and it is also forced into the grooves c, c, made upon the cylinder by means of a silk string tied round the periphery of the board C. When the taffetas becomes loose after long use, this string is taken off till the taffetas is again brought to a proper degree of tension. The cylinder, when mounted on its frame, and covered with a catskin, is shewn in Fig. 8. The catskin reaches from F to G, and has at F three silk strings, by which it is hooked on as many wooden hooks, H, H, H, fixed to the principal board of the machine. It is merely laid round the taffetas cylinder, and the attraction produced by the electricity, excited during the motion of the cylinder, is more than sufficient to keep it in every part perfectly close to the taffetas. This is an advantage which cannot be obtained in any machine, where the cylinder or plate presses against a fixed cushion. The contact between the rubber and the cylinder is thus rendered totally independent either of the form of the cushion, or the true centering of the cylinder. The hairy side of the catskin is placed in contact with the taffetas, and its other side may be covered with silk or any other stuff. In order to prevent the cylinder from turning in the wrong direction, a wooden ratchet wheel K is fixed to the axis, and its hook to the frame of the machine. The conductor M receives the electricity from the cylinder merely by one single point. As the catskin should always be very dry, it would be convenient to have two, one of which ought to be drying at the fire when the other is in use. Dr Hamel has observed that these machines always act most powerfully in a dry cold winter day, when the temperature of the external air was 80 or more degrees below the zero of Fahrenheit's scale, whatever was the temperature of the room in which the machine was placed.

CHAP. II.

Description of the Electrophorus of Volta.

As the electrophorus of Volta is obviously an electrifying machine of a particular form, the description of it belongs to the present Chapter. This ingenious instrument was invented by M. Volta, professor of natural philosophy at Como, and now at Padua, about the year 1774. It is represented in Plate CCXLVIII, Fig. 9, where A is a circular metallic plate, or a plate of wood covered with tinfoil, which has a glass handle screwed into a brass or wooden nut D. The edge of this plate must be pretty thick, and well smoothed and rounded off. The lower plate B consists of a resinous cake placed upon another metallic plate, and formed by pouring the resinous compound when fluid upon a metallic plate with a circular rim. This resinous plate is formed by melting together equal parts of shell lac, resin, and Venice turpentine; and if the plate is required to be formed separate from the lower conductor, this composition should be poured while hot upon a marble table, from which it can be readily separated when cold. The three plates which compose the electrophorus may be distinguished by the letters A, B, C, A being the upper conductor, B the resinous plate, and C the lower conductor. The leading phenomena exhibited by this instrument are given in the following experiments:

Exp. 1. If the resinous plate has been formed by being melted upon the lower conductor in a state of insolation, it will be found to possess negative electricity, and a spark may be drawn from any part of the compound plate BC, particularly from the lower conductor. This electricity, however, gradually dissipates.

Exp. 2. Rub the resinous plate with a piece of flannel, or fur, or, what is still better, whip it with a fox's tail, or a piece of catskin, and having placed the upper conductor A upon the resinous plate B, raise it again by its insulating handle, and the upper conductor will exhibit no signs, or very faint signs of electricity.

Exp. 3. Replace the upper conductor upon the resinous plate B, and touch it when in this situation with the finger, or with any other uninsulated conducting substance. Let it then be raised by the handle, and it will not only exhibit indications of positive electricity, but will afford a sharp spark. Let the plate A be again placed upon B, and again raised, and it will afford another spark, and this process may be repeated for a considerable time, till no spark is obtained. This exhaustion may be effected at once; for if we when we touch the raised plate A with the finger, we at the same time touch the lower conductor with the thumb, a sensible shock will be felt in the finger and thumb, and they will no longer exhibit any electricity.

Exp. 4. Let the upper conductor A be now placed upon the excited plate B, by means of its glass handle, and then bring the knob of a Leyden jar in contact with it. The leaves of an electrometer when touched with the knob of the jar, will then diverge with negative electricity. Let the upper conductor be now raised, and the knob of the jar again presented to it, and a spark will pass between them. If the knob of the jar is now brought into contact with the negatively electric electrometer, its divergence will be instantly destroyed. This effect is obviously produced by an equal quantity of positive electricity; for if the positive electricity had exceeded the negative electricity, the leaves would have again separated with the excess, and remained slightly positive; on the contrary, if the negative electricity had exceeded the positive, the divergence would not have been totally destroyed. This experiment is by Mr Singer.

Exp. 5. If the lower conductor C is now insulated, it will exhibit negative electricity, when the resinous plate B only is placed upon it, but when the upper conductor A is placed upon B, the electricity of the lower conductor C will change to positive. When the plate A is again raised, C will become negative. Hence the two conductors are always in opposite states of electricity.

When the electrophorus is well made, it may be em-
employed instead of an electrical machine. Mr Singer informs us, that about 20 sparks from the upper conductor, when raised, is sufficient to charge a Leyden phial of a moderate size.

Sometimes the resinous plate of the electrophorus is placed upon a plate of glass.

Dr Ingenhousz informs us, that the electricity produced by the electrophorus may be varied by transferring alternately the upper conductor from one resinous cake to another, and touching it after it is placed on the cakes. By this method, both cakes continually acquire more and more electricity, so that the upper conductor returns from either plate quite overcharged, and Leyden phials may be charged by it so very strongly that they may be broken by the charge. The conductor returns from one cake in a positive, and from the other in a negative state. This method of increasing the electricity, was communicated to Dr Ingenhousz by Dr Klincock of the University of Prague.


CHAP. III.

On Electrical Kites, Thunder Rods, and Conductors for collecting the Electricity of the Atmosphere.

We have already seen in our History of Electricity, and in the Section upon the Electricity of the Atmosphere, that lightning is identical with electricity, and that all the experiments made with a common electrifying machine may also be made with the electricity which is brought down from the atmosphere. The instruments which have been used for this purpose are electrical kites, for bringing it down from the higher regions of the atmosphere; thunder rods for collecting it from the lower strata; and conductors for carrying it off to the ground. The terms thunder rods and conductors are generally employed as synonymous; but in the present Chapter we have given the name of thunder rods to those instruments which are employed for collecting electricity for the purposes of experiment.

Sect. I. On Electrical Kites.

The electrical kite constructed by Dr Franklin consisted of two light stripes of cedar wood put together in the form of a cross, the arms being so long as to extend to the corners of a large thin silk handkerchief when properly stretched out; the corners of the handkerchief were then tied to the extremities of the cross, so as to form the body of the kite. It was then supplied with a tail, a loop, and a string, and was better able to withstand the resistance of a thunder storm than if it had been made of paper. To the top of the upright stick of the cross, Dr Franklin fixed a sharp pointed wire, which rose to more than a foot above the wood. To the lower end of the string made of twine, he tied a silk ribbon, and fastened a key at the junction of the silk and the twine. The kite is then raised during a thunder storm, and the person who holds the string stands within a door, or window, or under cover, so that the silk ribbon may not be wet, and so that the string does not touch the frame of the door or window. When the kite and the string are wetted by the rain, the electricity will stream out from the key when the knuckle is presented to it, and a Leyden jar or a battery may be readily charged.

In our account of the experiments made by M. Romas, we have already given a general description of the electrical kite which he employed. The twine string employed by Dr Franklin, was obviously unfit to conduct the electricity of the atmosphere until it had been wetted by the rain. In order to obviate this and other defects, M. Romas made the string of twine twisted round with a copper wire. Having formed a pretty stout thread of good hemp, he doubled it, and twisted the two threads and the metallic wire at the same time, so as to form only one string. In this manner, the string acquired a degree of strength, which rendered it capable of resisting the rough usage to which it must necessarily be subjected. In this state, he took another hempen cord, and twined it round the string, but at intervals of two feet he sewed it to the other threads, so that it should be broken by any accident, the continuity of the cord would not be broken for any considerable extent. Having received a severe shock from the lightning when he was raising the kite, M. Romas contrived to elevate it without touching the cord. This he effected by means of a small chariot, with which he could let out the string as rapidly or slowly as he chose.

Mr Cavallo, in his experiments on atmospheric electricity, generally used school-boys' kites, about 4 feet high, and 2 feet wide, the strings being formed, like that of Romas, of threads of common twine and copper wire, such as is used for trimming. In order to protect himself from danger, he usually hung a chain from the string, the end of which fell to the ground; and at other times he stood upon an insulating stool. When the kite was raised, he commonly brought the string through a window, and fastened it to a strong silk lace, the end of which was generally tied to a heavy chain in the room. By means of a small prime conductor standing upon a table, and connected with the string by a wire, he observed the character of the electricity which was brought down.

Mr Cuthbertson, in his Practical Electricity, has given a drawing of the apparatus which he employed in raising electrical kites, and which does not differ essentially from those which we have described. The string of the kite is coiled round a horizontal axis, supported upon three mahogany legs; and round a drum, on a thicker part of the same axis, is coiled a silk cord, the other end of which is again coiled round another axis or reel 20 or 25 feet distant, which is moved by a winch; by turning this winch, the string of the kite can be lengthened or shortened at pleasure without any danger.

Mr Cuthbertson sometimes used three kites all connected with one another; and on one occasion, when he could obtain no electricity with a kite having a string 500 feet long, he succeeded by adding other two, each of which had strings 500 feet in length. For further information on the construction of kites, see Franklin's Letters, p. 90, or Phil. Trans. 1751, p. 365; Romas, Mem. de Savanes Etrangers, tom. iv. page 514, &c.; Berthol, De l'Electricite des Meteores, tom. i. p. 51, 53; Cavallo, Phil. Trans. 1776, p. 407; Id. 1777, p. 48; and Cuthbertson's Practical Electricity, p. 237-244. Lond. 1807.
In our Section on the history of the atmosphere, we have already given an account of the simple thunder rods which were employed by Le Monnier, Mazeas, Becaria, Dalibard, and Delors. We shall, therefore, describe the present more complicated instruments constructed and used by Mr Read, Mr Cavallo, and Mr Ronalds.

The instrument employed by Mr Read, in the experiments of which he has already given a full account, is represented in Plate CCXLVIII. Fig. 10, where AA is a wooden rod 20 feet long, and 2 inches in diameter below, and 1 above. A solid glass pillar B covered with wax, 22 inches long, is cemented into the lower end of it, and along with the whole rod is supported upon a wooden pedestal C, at the end of an iron bracket driven into the wall. At the distance of 13 inches from D, a strong arm of wood E is fixed into the wall, holding a glass tube F, covered with sealing-wax. The rod AA passes through the tube, and thus stands at the distance of 12 inches from the wall. The tube F is lined with cork, so that when the rod is bent by the wind, it is thus prevented from touching or breaking the tube. At the upper end of the rod are several sharp pointed wires G, two of which are of copper, and about one-eighth of an inch thick, and one of them is twisted round the rod to the right, and the other to the left, so as to reach the brass collar at the top of the lower funnel H, to which they are soldered. The two funnels H, H, are intended to defend the glasses B, F, from the weather. A hole is bored through the wall at I, to receive a glass tube coated with sealing-wax, through which a strong brass wire is conveyed from the rod into the room. At the end of the glass tube it passes through a brass ball 2 inches in diameter; and proceeding a little farther, it keeps suspended at its extremity a pitch ball electrometer K, at the distance of about 12 inches from the wall. The outer end of the glass tube is kept dry, by a wooden box on the outside of the wall. A bell N, supported on a strong wire, is placed at the distance of 2 inches from the ball L, and the wire of the bell communicates by a metallic continuation with the moist ground. This bell is rung by a small brass ball three-tenths of an inch in diameter, suspended from a nail at O. A small table P is erected, for holding jars and other pieces of apparatus for making experiments. Mr Read afterwards brought all the insulated parts of this rod under the roof of his house, to preserve them from the moisture of the atmosphere.

When the insulation of his principal rod was so far injured by the moisture of the air that it exhibited no electrical indications, he made use of what he calls a hand exploring rod, which was about the length and thickness of a common fishing-rod, having plenty of small wires twisted round it from one end to another. In order to use this rod, he warmed the glass legs of an insulated stool, and having placed himself upon it, he raised with one hand the rod into a vertical position, where he kept it for a minute or two. With the finger of the other hand he touched a sensible electrometer, which pointed out the electricity of the atmosphere. When the electricity was too weak to produce any divergence in the pith balls, which did not often happen, he added to the rod a lighted torch, and placed it as far from his hand as the strength of the rod would permit; and by repeating the experiment, he always found the electricity sensible, being attracted more powerfully by the flame of the torch than by the extremity of the rod.

The atmospheric collector, with which Mr Cavallo made numerous experiments, is represented in Plate CCXLVIII. Fig. 11, where AB is a common jointed fishing-rod, which wants the last or smallest joint. A slender glass tube C is fixed at the extremity of this rod, and is covered with wax, having a cork D at its end, from which a pitch ball electrometer is suspended. A piece of cord HGI is fastened to the other extremity of the rod H, and is supported at G by a small piece of twine FG. A pin is fastened at the extremity I of the cord, and when it is pushed into the cork D, the pitch ball electrometer is in an uninsulated state. In order to observe the electricity of the atmosphere, he fixed the pin in the cork D, and taking the rod by the lower extremity H, he held it out of one of the highest windows in the house, and having raised it into a position inclined about 50° or 60° to the horizon, he kept it there for a few seconds; he disengaged the pin from the cork D, by pulling the twine at H; and the string dropping into the dotted position KL, left the electrometer insulated and electrified in a state opposite to that of the atmosphere. He then drew the instrument into the room, and examined the character of the electricity which it possessed.

In order to insulate a vertical atmospheric apparatus, Mr Singer has applied his new system of insulation, of which we shall give an account in our description of his electrometer. He proposes to employ a stick of glass 10 inches long, and one inch in diameter, coated with sealing-wax. The brass cap at each extremity, must have a screw to receive the lid of a cylindrical tin funnel. "There are to be two such funnels, one screwed at each end of the insulating pillar. They may be about 8 inches long, and one smaller than the other, in such proportion, that the circumference of the stick of glass, and the two funnels, may form a series of concentric circles, distant from each other about a quarter of an inch. The apparatus is represented by Fig. 12, the funnels being delineated by dotted lines. It is evident that in this apparatus, the vapour must first traverse the space between the outer and inner funnels, and then the interval between the inner funnel and the stick of glass, before the insulation can be destroyed; and this space may be lengthened to any extent, by increasing the number of concentric funnels. This arrangement is very simple and durable; and though the limit of its insulation is the distance of the funnels, that is, a quarter of an inch, this will be found sufficient for the most essential observations on the atmosphere; and the higher intensities may be obtained, if desired, by prolonging the insulator to some inches below the cap of the lower funnel, as shown in the figure, or by making this lower and internal funnel of a glass tube covered with sealing-wax.

If an apparatus of this description be used to insulate the horizontal wire, the open end of the larger funnel should have a circular tin plate of nearly twice its diameter, placed opposite to it, at a short distance, to prevent the intrusion of driving rain or snow. (Fig. 13.) Or, what might perhaps prove more effectual, it Fig. 13 may be placed within a sort of pigeon house, having a hole in its side for the wire to pass through."

Nearly upon the preceding plan of insulation, F. Ronalds, Esq. of Hammersmith, has erected an atmospheric apparatus, in a field near Highbury Terrace, Islington; but we have not yet seen an account of the observations which he has made with it. See Read,
Sect. III. On Conductors for the preservation of Buildings.

As soon as Dr Franklin established the identity of lightning and electricity, he applied this discovery to the great practical purpose of defending buildings from the effects of lightning. With this view he proposed to erect a metallic rod, pointed at each extremity, at the side of the building, so that it should rise to a considerable height above the highest part of it, and descend lower than its foundation, either into water, or the nearest conducting substance. Hence, if a thunder cloud is immediately above the building, its charge will be drawn off by the pointed conductor, and be transmitted silently to the earth; whereas, had it struck the unprotected building, the imperfect conducting bodies of which it is composed, would have exposed such a resistance to the passage of the lightning, that it would either have been considerably injured or destroyed.

When this instrument was first proposed, a dispute arose among the members of the Royal Society of London, respecting the propriety of making the conductors terminate in acute points. The subject was long and keenly agitated; but the party, headed by Mr Benjamin Wilson, who insisted upon the necessity of furnishing the extremities of the conductors with round balls, was ultimately baffled in the contest, and the use of pointed conductors now universally prevails. The advantages of conductors in the protection of buildings, have been generally illustrated by the experiments of the powder-house, the thunder-house, and the pyramid, of which we shall give a short explanation, for the sake of our young readers.

The thunder-house is represented in Fig. 14. of Plate CCXLVIII, where a thick piece of board A, representing the end of a house, is fastened into the base B. About 8 inches from A is fixed a glass pillar C, moveable about its axis, from the top of which proceeds a bent wire EF, having a spring socket F, through which a double knotted wire FG is moveable. In the piece of wood A is fixed a wire HL, with a knob H at its extremity, and another wire MN bent upwards at N, into a hole LMK, about 2 inch deep, and nearly one inch wide, is loosely fitted a square piece of wood, of the same shape, which can be taken out at pleasure. A diagonal wire IK is fastened to the piece of wood. Let a charged jar J be now placed near the apparatus, so that its inside coating communicates with the ball E by means of a chain, and its outside coating with the wire N by means of another chain. Having placed the balls G, H at a considerable distance, take out the piece of wood LMK, and put it in so that the wire IK lies in the direction ML, and forms a communication with the wires HL and MJ; then bring the balls G, H gradually nearer one another, and at a certain distance the jar will explode, and no particular effect will be produced: the explosion being carried off by the continuity of the conducting wires. Let the wire IK be now placed as in the figure, so that there is an interruption in the conducting wire HLMN, and let the jar be exploded as before. The piece of wood LMK will now be thrown out of its place to a considerable distance, as the electricity does not find a ready passage from L to M. In this experiment, the explosion of the jar may represent a thunder cloud above the chimney of the house A, which is saved when protected by a continuous conductor, but thrown down when the lightning does not find a ready passage.

The powder-house, as constructed by Mr Cuthbertson, is represented in Fig. 15. Plate CCXLVIII. The house is built of wood, A, which communicates with L by a brass wire; L Plate communicates with the ivory piece d by a brass chain; CXLVIII. and the ivory piece d communicates with the brass tube Fig. 15. c, standing in the brass dish e. This again communicates with the brass pipe k, which is connected with the hollow arm L. The tube c, and the ivory piece d, are then filled with loose gunpowder, and the brass pin is stuck into it within a quarter of an inch of the bottom. Alcohol is poured into the dish e; wetish gunpowder is put into k, and L is filled with gunpowder hard pressed. The house being then shut up, and its roof placed upon it, the outside of a Leyden phial is made to communicate with a hook below L; and as soon as the communication is complete, by making the inside of the jar communicate with the ball A, the explosion of the gunpowder in c and d will blow off the roof, and, inflaming the alcohol, will set part of the house on fire, and, after burning some time, it will kindle the gunpowder in the tube k, and when it is consumed, the powder in the arm L will be set on fire, and, after a loud explosion, the house will be blown up, and fall to pieces.

The pyramid consists of several pieces of wood placed one on another, the lowest piece forming a square base, and the pyramidal part resting upon this base by three small brass balls. A piece of wood is then loosely fitted into a square hole on one side of the base, and one of the brass balls is made to rest upon this piece of wood, so that the upper part of the pyramid will stand when this piece of wood is in its place, but will fall when it is thrown out. The piece of wood is so constructed that it can be made either to complete or to interrupt the communication between the upper and the lower wire, as in the thunder-house. When the interruption is completed, and an explosion takes place along the wires in the thunder-house, no effect will be produced; but, by interrupting the circuit, the piece of wood will be thrown out, and the pyramid will fall to pieces.

The effect of lightning upon ships may be shown by the following pretty experiment by Mr Cuthbertson. In Fig. 16. Plate CCXLVIII, where AB is a trough filled with water, C a ship swimming in it, so that the top of the mast may nearly reach the ball L. Place the ship as in the figure at the end of the trough, and, by means of a thread T attached to it, draw the ship under the ball L, connected with the two charged jars D, F, and the charge flying out of L will strike the mast, and break the ship in pieces. When the ship is repaired, unscrew the round piece of brass from the top of the spindle, and hang the chain q r upon it, having the star A screwed upon the top. Bring the ship, as formerly, with considerable rapidity under the ball L, and it will be struck by the shock, the fire being seen to pass along the chain, without touching the mast. But if the ship is drawn slowly forward, beneath the ball L, no discharge will be heard, as the electricity of the jar is drawn slowly off by the points of the star A.

Conductors for the preservation of buildings should be formed of a copper or iron rod, about 1/2 or 3/4 inch thick, made sharp at the point, and rising to the height of four or five feet above the highest part of the building.
ELECTRICITY.

BOOK II.

ON MACHINES FOR ACCUMULATING AND DISCHARGING ELECTRICITY.

SECTION I. ON THE CONSTRUCTION OF JARS AND COATED PLATES.

In our Section on the Accumulation of Electricity, we have already given a general account of the Leyden jar, and of electrical batteries, and shall therefore confine ourselves, at present, to some practical remarks on the construction and use of these instruments.

The best form of a jar is that of a cylinder, having its mouth sufficiently large to admit the hand, for the purpose of coating, cleaning, and repairing it. With this view, jars completely cylindrical were for some time employed, particularly by Mr Cuthbertson; but he afterwards found that it was better to have them a little contracted at the mouth. Dr Robison prefers bottles of a globular form, and he frequently used the balloons employed in distillation.

The glass of which the jars are made should have no more thickness than what is necessary to prevent them from being broken by a spontaneous discharge; for Mr Cavendish has found that the quantity of electricity necessary to charge different coated jars of the same extent, is inversely as the thickness of the jars.

The best method of coating jars, is to line them both on the outside and the inside with tinfoil, which may be made to adhere to the glass by gum water. When the jars, however, will not admit of being lined with tinfoil, or when tinfoil is not to be got, a coating of brass filings may be laid on with gum water, or a quantity of gold leaf or Dutch metal may be placed in the jar, so as not to rise higher than the external coating. When the jar has a globular form, it should be coated by cutting the tinfoil into groes or joints, in the same manner as terrestrial and celestial globes are covered. A coated jar is shewn in Plate CCXLIII. Fig. 5.

As jars are very often broken by the spontaneous discharge through the glass, Mr Brooke proposed, as the result of experiment, that the tinfoil should be first pasted upon common writing paper. When this precaution was taken, he very seldom had any of his jars broken.

For the purpose of preventing the charge of the jar from being dissipated, it is of great advantage to cover the uncoated part with melted sealing-wax or with varnish, to prevent the deposition of moisture from the atmosphere.

In order that the jar may retain its charge for a considerable time, it is constructed, as in Plate CCXLVII. Fig. 1, where it is shewn suspended at the end C of the conductor. After being coated in the usual manner, a glass tube abc, reaching to the bottom, is cemented into the cap. The inside of this tube is covered with tinfoil rather more than half its length from the bottom, and this lining communicates with the inner coating of the jar. A wire c, blunted at the lower end, and half the length of the tube, is placed loosely in a hole in the brass cap, so that when the jar has the position in the Figure, the wire c forms a communication between the brass cap and the inside coating; but when this wire is drawn up or taken out, there is no communication of the internal coating either with the brass cap or with the external air. The phial will consequently retain its charge, and may be carried about in the pocket till it is needed.

M. Cavallo has invented a curious instrument, which he calls a self-charging phial. It consists of a glass self-charging phial.

JAR FOR RETAINING ITS CHARGE.

PLATE CCXLVII. Fig. 1.

Morgan's method of coating jars.

Practical Electricity.

Morgan's method of protecting a house.

Conductors for ships.

Precautions during a storm.

Form of the jars.

Thickness of the glass.
was then coated with tinfoil all but the neck. The tinfoil formed the inner coating and wire, and the tinfoil the outer coating, while the wax acted the part of glass in the common jar.

Sect. II. On Coated Plates.

We have already seen that electricity may be accumulated as well in a coated plate as in a coated jar, and we have represented a plate of this kind in Fig. 7 of Plate CCXLI. Mr Bevis was the first person who substituted coated plates of glass instead of jars, and Dr Franklin actually used a battery consisting of coated plates of crown glass. As the accumulation of the electric matter increases with the thickness of the glass, Muscovy tafle has been substituted in place of glass, and it has the additional advantage of being less liable to attract moisture from the atmosphere. Instead of glass, Beccaria employed a resinous plate consisting of equal quantities of pure colophony and powder of marble, and having previously stuck a piece of tinfoil within five inches of the edge of the table, he poured this composition, when melted, upon the table, and having spread it to the thickness of a 10th of an inch with a hot iron, he coated the upper side with tinfoil, and found that it had the power of accumulating a greater degree of electricity than an equal plate of glass, and was less liable to be broken by a spontaneous discharge.

Sect. III. On the Construction of Batteries.

The electrical battery was invented in the year 1746, by Gralath, a German. Dr Franklin constructed one of coated plates of glass. Dr Priestley employed one of 61 jars; but the largest that have ever been made are those which Mr Cuthbertson made for the Teylerian Museum of Haarlem.

The jars which compose a battery are formed and coated in exactly the same manner as a single Leyden phial. In Figs. 8 and 9, of Plate CCXLI, we have given a representation of two batteries, showing two different forms of the jar, and two different manners of uniting the separate effects of each.

The real measure of the power of batteries ought not to be estimated by the number of square feet of coated surface which they contain, but by the length of metallic wire which they are capable of igniting or exploding. In the year 1774, Mr Nairne constructed a battery, containing 50 square feet of coated surface, and he found that it was capable of igniting 45 inches of iron wire, of the 14th part of an inch in diameter, which corresponds to about 4ths of an inch of wire for each square foot. The first battery constructed by Mr Cuthbertson for the Teylerian Museum, contained 132 square feet of coated surface, and was capable of igniting about 180 inches of the same kind of wire, which is nearly one inch and 4ths of wire for each square foot, surpassing considerably the power of Nairne's battery. When this battery was increased to 225 square feet of coating, it ignited 300 inches of the same wire, which was also at the rate of one inch and 4ths for each square foot. The large battery of 100 jars, which Mr Cuthbertson afterwards completed for the same museum, contained 550 square feet, was capable of igniting 635 inches of the same wire, which was also at the rate of one inch and 4ths for every square foot. Mr Cuthbertson afterwards made a number of batteries of 15 jars each, and having about 17 square feet of coated surface. Calculating from Nairne's battery, these small ones ought to ignite 15½ inches of wire, and calculating from the Haarlem batteries, they ought to ignite 22 inches; but Mr Cuthbertson found them capable of igniting 60 inches of the same wire. This remarkable increase Mr Cuthbertson could not easily explain. The Haarlem batteries were made of Bohemian glass, and the small batteries mentioned above were made of flint glass; but Mr Cuthbertson does not think that the difference of power can be ascribed to this cause.

Mr Brooke had observed that a coated jar took a much higher charge when it was dirty than when it was clean; but he does not seem to have made any experiments to investigate this singular fact. In the year 1792, Mr Cuthbertson happened accidentally to observe, that a jar when it is a little damp in the inside, (which it always is when fresh coated,) took a higher charge than when it had been coated for some time and dry. He then tried the power of a jar when it was damp by breathing into it, and found that it was capable of igniting 12 inches of wire, whereas it ignited only 5 inches when well dried. In March 1796, in very dry weather, Mr Cuthbertson charged a battery of 13 jars, and 17 square feet of coated surface, and found that it ignited 18 inches of wire; but after breathing into each jar through a glass tube, and then charging the battery, he was astonished to find that it was then able to ignite 60 inches of the same wire. In order to examine this subject more accurately, Mr Cuthbertson constructed his compound electrometer, which will be described in the next Chapter, and instituted a set of experiments to determine in what degree the charging capacity of coated jars is increased by breathing into them. The result of these experiments was, that the force of batteries did not increase with the quantity of coated surface, but according to the law already given in page 499. Hence it resulted, that instead of the power of a battery being increased 4 times, as he at first supposed, by breathing into the jars, the increased effect was only two-thirds. This increase, however, is still sufficiently great to make us regard Mr Cuthbertson's discovery of the effects of dampness, as one of the most valuable additions which has for a long time been made to practical electricity.

An effect, similar to that of breathing into the jar, may be produced by placing a wet sponge within it, or by slightly oiling its surface; but as these methods are not permanent, it has been recently proposed to paste a slip of writing paper an inch broad on the interior surface of the jar, so as to rise about half an inch above the upper edge of the inner coating.

Sect. IV. On Instruments for discharging Jars and Batteries.

A description of the common discharging rod has already been given in a former Section. Discharging rods with only one branch, and having glass handles, are shewn in Plate CCXLIX, Fig. 2, and are of great service in many experiments, for completing the electrical circuit, by fastening a wire at the end a of the metallic branch ab. A jar may be discharged, as represented in Plate CCXLIX, Fig. 3, by connecting with the outside coating a bent arm be, attached to a ring de, and by suspending any conducting body c by a silk thread between the knobs a and b. The body c will oscillate between these balls till the jar is discharged. When the body c is shaped into the form of a spider, this experiment has been called the electrified spider.
1. Henley's Universal Discharge.

One of the most useful instruments for discharging would, was invented by Mr. Henley, and is represented in Plate CCXLIX, Fig. 4, where AB is a mahogany board 14 inches long and 4 wide; C, D two glass pillars cemented into the base AB, and having upon their upper extremities brass caps, and above them spring tubes m, n, which turn round joints at o and p, that have both a vertical and a horizontal motion. In these springing tubes, two wires are placed, having a ring of brass at one end and a knob at the other. The small table EF, about 5 inches in diameter, has a piece of ivory inlaid upon its surface, and may be raised or depressed by the screw nut s. The small mahogany case, represented in Fig. 5, is sometimes placed in the socket e instead of the table EF. It consists of two boards, which can be pressed together by the two nuts p, q. When this instrument is required to be used, the body through which the discharge is to be passed, must either be laid upon the table EF, or fixed in the press, Fig. 5. The balls of the sliding wires must then be brought in contact with the opposite sides of the body, and when one of the rings of the wires is connected with a jar or a battery, while the other ring is connected with the discharging rod, the charge will be sent through the body with the greatest accuracy. In many experiments, wires pointed at the extremities are used instead of those which have knobs.

2. Simple Discharging Electrometer.

This simple instrument, which is generally attached to plate glass machines, is nothing more than a brass ball at the end of a brass stem 14 inch long, movable in a hall and socket upon the top of a glass rod fixed into the base of the machine, so that the brass ball is about one inch distant from the brass ball of the conductor adjacent to the piece of wood on which the receiving points are fixed. The brass ball of this discharger can therefore be set at any distance, within certain limits, of the conductor, and hence it enables us to regulate the magnitude either of the sparks given by the conductor, or the shock of a jar connected with the conductor. When the ball of the electrometer, for example, is placed near the conductor, the electricity of the conductor or of the jar will always be carried off when it reaches a certain magnitude, proportional to the distance of the electrometer ball from the conductor.

3. Lane's Discharging Electrometer.

This instrument, which is universally used, is represented in Plate CCXLVII. Fig. 2, where fe is a piece of brass fixed into the end of the conductor D. This arm carries a bent piece of glass edc, having a brass cap at its extremity. Through a spring tube within this cap passes an arm of brass ab, having a ball a, b at each extremity. The arm ab is then connected with the ground by means of a chain, as shown in Fig. 1, where the electrometer has a different position upon the conductor. When the ball a is brought near the conductor D, the charge of the conductor will be carried off into the ground, by means of the chain when it has reached a certain magnitude. If the ball a is pushed to a greater distance from D, the conductor will require to have a higher charge before it passes to the ball. In this way, the distance of the ball a from the conductor becomes a measure of the electricity which it contains at the instant of the discharge. In Fig. 6, this instrument is represented as attached to a jar, but, in this case, the outer ball or ring must be connected with the external coating of the jar. This electrometer is represented under a different form at L, in Figs. 4 and 5.

CHAP. II.

On Instruments for Measuring Electricity.

Instruments for measuring electricity have received the name of Electrometers. An apparatus which has been given to those that indicate the presence of small quantities of electricity, as well as to those which afford an exact measure of its intensity.

SECT. I. On Instruments that indicate Small Quantities of Electricity.

1. The Abbé Nollet's Electrometer.

The electrometer used by the Abbé Nollet consisted of two silk threads, which indicated by their divergence in the presence of small quantities of electricity, and he even attempted to measure their magnitude by ascertaining the angle of divergence from the shadow of the threads upon a board. This electrometer was improved by Mr. Waitz, who suspended small weights to the silk threads.

2. Canton's Electrometer.

This instrument consisted of a pair of balls turned out of the dry pith of the elder. These balls were suspended by the finest linen threads. Mr. Canton kept them in a narrow box, with a sliding cover, and when he wanted to use them, he held the box by the end of the cover, and permitted the balls to hang freely from a pin to which they were suspended. This instrument is represented in Plate CCXLIII, Fig. 1, as placed upon an insulating stand. The balls are here shown in a state of divergence.


A perspective view of this instrument is shown in Plate CCXLIX. Fig. 6, and a section of it in Fig. 7. It consists of two strips of gold leaf m, n, suspended within a glass cylinder ABED. This cylinder has a brass cap AB, considerably broader than itself, in the centre of which is a hole a in the inside of the cap, which receives a small wedge of wood. On each side of this wedge two equal stripes of gold leaf, free of all raggedness at their edges, are fixed by a little varnish: these stripes are generally about two inches long, and about a quarter of an inch broad. The inside of the cap AB, and the upper part of the glass cylinder, are coated with sealing-wax. On the inside of the glass cylinder are pasted two stripes of tinfoil b, c, diametrically opposite to each other, and rising higher than the stripes of gold leaf. The lower ends of the tinfoil are in contact with the brass stand DEF, which supports the whole. In order to observe the electricity of the atmosphere, a pointed wire C is inserted in the brass cap AB. In order to use the electrometer, turn round the cap AB till the surfaces of the gold leaf are parallel to the surfaces of the pieces of tinfoil b, c, so that the two stripes of gold leaf may hang in contact in the middle of the cylinder. Then, if a body containing a small quantity of electricity be brought in contact with the cap AB, the gold leaves m, n will diverge, and their extremities will strike the
ELECTRICITY.

Mr Cavallo has proposed to improve this electrometer, by sticking two small pieces of gilt paper to the ends of the gold leaves.

Nicholson's Improvement on Bennet's Electrometer.

As the divergency of the gold leaves in the preceding instrument is increased by the stripes of tinfoil b, c, it might happen that the electricity was so weak that it could only be rendered sensible by having the stripes b, c brought very near to the gold leaves. With this view, Mr Nicholson constructed an apparatus, in which he substituted two flat radii of brass in room of the tinfoil, and, by means of a microtorn screw placed at the foot of the glass cylinder, he was able to open and shut the two radii of brass, so that their extremities could be brought within any distance of the gold leaves. The divergency of the brass radii afford a kind of measure of the intensity of the electricity. A drawing and description of this improved instrument may be seen in Nicholson's Journal, September 1797.

Cavallo's Electrometers.

The electrometers constructed and used by Mr Cavallo are represented in Plate CCXLIX. Figs. 8 and 9. Fig. 8, is his pocket electrometer, shown in its inner case at A, and in a state of action at B. The inner case or handle is made of glass, and is about three inches long, and 1/2 of an inch wide, half of it being covered with sealing wax. To the open end of the tube is fitted a cork which tapers at both ends, so that any end of it will suit the end of the tube. Two small cones of the pitch of elder are then suspended to two linen threads attached to one end of the cork. When the electrometer is to be used, the end of the cork opposite to the threads must be put into the tube, and the tube will form the insulated handle of the electrometer, as shown at B. The case of this electrometer, shown at C, contains a piece of amber at one end, for electrifying the electrometer negatively, and at the other end a piece of ivory insulated upon a piece of amber, for giving positive electricity when rubbed with woollen cloth.

Another electrometer of Cavallo's is represented in Fig. 9, at A, which does not differ very essentially from Bennet's, having small conical pieces of the pitch of elder, instead of gold leaves. These balls are suspended by two silver wires, which hang parallel to one another when the balls are at rest. The wires are shaped like rings at the top, and hang very loosely in holes, in a piece of ivory H. The cap of the electrometer has a particular construction, which will be seen at B.

Sauassure's Electrometer.

This electrometer is represented in Fig. 10, of Plate CCXLIX, and has a general resemblance to that of Cavallo's. The balls are round, and made of the pitch of elder. They are about half a line in diameter, and are suspended to the most delicate silver wires. The glass vessel ACB has a bell shape, and is so wide that the balls g, g, even at their greatest divergency, cannot reach the stripes of tinfoil h, h within the glass. In order that they may give out all their electricity, Sauassure used four stripes of tinfoil instead of two, each internal stripe having a corresponding one on the outside. The bottom BC is made of metal, and upon the edge of it is a divided scale, for measuring the divergency of the balls. This instrument of Sauassure's was extremely sensible; but

The following Table contains the electrical forces corresponding to the divergency of the balls, as determined by experiments.

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<tr>
<th>Distance of Balls in quarters of a line.</th>
<th>Corresponding forces of Electricity.</th>
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This instrument consists of a needle of silver or brass, terminated by two globules, and movable upon a pivot, which forms the upper part of a stem of the same metal. The needle and stem are insulated, by being placed upon a cylindrical support of rosin. If a finger of the left hand is now placed upon the bottom of the metallic stem, while the right hand presents a piece of roughed sealing wax, during a second or two, at a small distance from the stem, then, if the finger is first withdrawn, and afterwards the stick of sealing wax, the needle will be negatively electrified, and will be ready for examining the poles of a mineral that is rendered electrical by heat. See Hus's Traité de Physique, tom. i. and Traité de Mineralogie, tom. i. and Plate VIII. Fig. 76, of that work.

8. Singer's Electrometer constructed upon a new principle of Insulation.

In order to produce a more perfect degree of insulation than had been before obtained, Mr Singer proposes to inclose the insulator within a narrow channel so that the moist air in contact with it may be limited in quantity, and little disposed to motion. In this way, the contact of the atmosphere with the insulators will be least free, and the transition of moisture to them necessarily retarded. In applying this principle to the perfection of the gold leaf electrometer, Mr Singer makes the insulation depend on a glass tube 4 inches long, and 1/2 of an inch internal diameter. It is coated on every side with sealing wax; and a brass wire, 1/4 or 1/2 of an inch thick, and 5 inches long, passes through its axis, so as not to touch any part of the tube, in the middle of which it is fixed by a plug of silk. This construction is shewn in Fig. 11, of Plate CCXLIX. Plate where A is a brass cap screwed upon the upper part of the tube B, the wire w, which keeps the atmosphere from having free contact with the outside of the tube B. The gold leaves are fastened at the end of the wire, and the glass
ELECTRICITY.

Sect. II. On Electrometers for Indicating and Measuring Electricity.

1. Henley's Quadrant Electrometer.

This instrument is represented in Plate CCXLVII. Fig. 11, where AB is a smooth round stem, about 7 inches long, surmounted by a ball A. Below this ball, and at one side of the stem, is fixed a semicircle of ivory C, having its lower quadrant divided into 90 degrees. A thin piece of cane mm, 4 inches long, with a ball n at its lower end, is suspended from a pin at m in the centre of the graduated arch, and turns freely round that pin as a center. When the instrument is electrified, the ball, which naturally hangs in a vertical direction, is repelled by the stem, and indicates the electrical force by its angular distance from the stem. This instrument may be either placed on a stand, like D, or it may be fixed at the end of a conductor, or upon the top of a Leyden jar. It is quite obvious, that equal spaces on the quadrant correspond to equal degrees of electricity. M. Aehard has shown, that the quadrant should be divided according to a scale of arcs, the tangents of which are in arithmetical progression.

2. Brooke's Steelyard Electrometer.

This ingenious, though complicated and expensive, instrument, is founded on the principle, that the charge of a jar or battery may be accurately determined by the weight in grains, which the repulsive force of the accumulated electricity is able to raise. This instrument, which is represented in Fig. 13, Plate CCXLIX. is supported upon a base AB, about 9¾ inches in diameter, and is completely insulated upon the glass pillar DD. The arms G and g, which may be hollow tubes of copper, have a motion round the brass wire H, so as to be turned as far away as possible from the jar or battery. The balls IK are made of hollow copper, so as to be as light as possible. The arm G is screwed to a solid piece within the ball F, and has a motion round an axis close to the surface of the ball F, in a vertical plane. The arm E has also a motion in a vertical plane round an axis concealed behind the dial plate R, and by means of a multiplying motion behind the dial plate, the index R performs one complete revolution, while the arm E moves through 90°, or from a vertical into a horizontal position. By means of the apparatus NPH, which we have not room to describe, the electrometer is connected with the conductor, or the jar, or the battery, and all the parts of it are electrified positively or negatively according as it gives positive electricity. The two balls I, K, will of course repel one another, and the arm G will rise in a vertical plane. In the same manner the ball L will repel the other ball C, and the arm EC will rise in a vertical plane. The angular motion of EC is indicated upon the outer edge of the dial plate, divided into 90° by the lower and longer arm of the index, and the force of repulsion by which the arm GI is raised, is marked in grains upon the inner circle; to which the shorter arm of the index points. In order to graduate the inner circle, a weight m is moved upon the arm GI, till it exactly counterbalances the weight in F at the other end of the lever. One end of the weight m will therefore be the zero, or commencement of the scale. Then having shifted the weight m nearly to the ball I, find, by a pair of scales, the weight of the ball I, or the weight produced in consequence of the motion of m towards I. Divide this space into the number of grains thus found, and subdivide the space, corresponding to each grain, into halves and quarters. These divisions may be readily transferred to the inner circle of the dial plate, by observing the position of the shorter index when m is standing at any number of grains in the arm GI. When this is done, Mr. Brooke even thinks that the arms G, g, and balls I, K, may be removed as unnecessary. This ingenious instrument, though never brought to perfection by its author, has given rise to several admirable electrometers founded upon the same principle, of which we shall give a particular description.

3. Hauch’s Improved Discharging Electrometer.

This instrument is an improvement upon the electrometer of Mr. Brooke, which M. Hauch has greatly simplified. It consists of two levers with unequal arms, supported on separate glass pillars, one of which is a little higher than the other. The end of the longest arm of the upper lever being raised by the repulsion of a ball with which it is in contact, acts upon the end of the shortest arm of the lower lever; and the end of the longest arm of the lower lever, by being thus raised, touches the apparatus of the upper lever, and discharges the jar or battery. Our limits will not permit us to give a more detailed account of this instrument; but a drawing and description of it will be seen in the Phil. Mag. vol. iv. p. 267, or in the Transactions of the Royal Society of Copenhagen.

4. Dr. Robison’s Compareable Electrometer.

This ingenious instrument, which is also an improvement upon Brooke’s electrometer, was employed by Dr. Robison in his experiments on the law of electrical action. It is represented in Plate CCXLIV. Figs. 5. and 6. and has been fully described in p. 440, 441.

5. Coulomb’s Torsion Balance Electrometers.

These ingenious instruments, three of which we have given representations of in Plate CCXLIV. Figs. 7—11. and Plate CCXLV. Figs. 1—3. have been already fully described in pages 441, 442, 450, 451, and are undoubtedly the most accurate instruments that have ever been made for measuring small quantities of electricity.


This instrument is represented in Plate CCXLIX. Fig. 14, where D, E are two glass pillars fixed in the base AB, 18 inches long and six inches broad. These supports terminate in brass balls D, E, under the last of which is a brass hook for connecting it with the outside of a jar: upon the top of a brass pillar DB is supported the metallic wire GH, terminating in two equal balls, and balanced like a scale-beam on a knife-edged centre, the ball b so constructed as to allow the arm GH to move in a vertical plane. A rectangular arm of brass FCD is fixed at D. The arm Gb is divided into 60 grains, and carries a slider g, which can be set at any number of grains. A common Henley’s quadrant electrometer is placed at k. If the balls G and F are electrified, and the slider g be set at 0, they will repel one another; G will ascend, and H will descend
BOOK IV.
ON INSTRUMENTS FOR CONDENSING, DOUBLING, AND MULTYPING ELECTRICITY.

The electrometers described in the preceding Book, though extremely delicate, are unable to indicate the presence of weak degrees of electricity. In order to remedy this defect, several ingenious instruments have been employed for condensing, doubling, and multiplying small degrees of electricity. The most important of these, we shall now proceed to describe.

CHAP. I.
INSTRUMENTS FOR CONDENSING ELECTRICITY.

Sect. I. Volta's Condenser.

This instrument is nothing more than an application of the electrophorus already described. Having constructed an electrophorus with a very thin resinous plate, and having its electricity completely extinguished, lay the upper conductor upon this resinous plate in full contact, taking care that it does not touch the lower conductor. A wire is now brought from the place where the weak electricity exists to the upper conductor above this. The apparatus being left a certain time in this situation, till the upper conductor has accumulated a sufficient quantity of electricity, remove the conducting wire, and raise the upper conductor from the resinous plate by the insulating handle, and it will be found to have condensed so much electricity as to affect the electrometer most powerfully, and even to give sparks. As the thin resinous cake may receive some electricity, Volta substituted in place of it an imperfectly conducting substance, such as a clean and dry marble slab, a plate of wood clean and dry or covered with a coat of varnish, or even a conducting body covered with a piece of dry taffy or other dry silk.

Volta's Condenser connected with an Electrometer.

This instrument, which Volta has employed for determining the effects of Galvanic electricity, is represented in Plate CCXLIX. Fig. 13. The electrometer consists of two slips of straw or, us, perfectly even and upright. These straws are suspended by means of two metallic wires terminating in hooks, which move freely in two small holes made in the lower end of a piece of metal, whose upper extremity is soldered beneath the stopple of the jar. Above this stopple is cemented the collecting plate or base of brass ed, from the lower surface of which proceeds a metallic wire tipp with a metallic globule g. Above this plate is another plate ab, with an insulating glass handle mn, and communicating with surrounding bodies by a slip of metal lg, bent in such a manner as not to come near the collecting plate. The lower surface of ab, and the upper surface of ed, are both varnished. A graduated scale tz is placed on the outside of the jar for estimating the angular distance of the straws when in a state of divergency. The electrified body is brought repeatedly in contact with a small globule g, and after a certain number of contacts, the upper plate ab is lifted up, and the straws immediately diverge.

Sect. II. Cavallo's improved Condenser.

It occurred to Mr. Cavallo, that if the condensing plate of the electrophorus indicated small degrees of electricity that could not otherwise be observed, another smaller plate, or small condensing apparatus, might be employed, to condense the weak electricity of the large plate. He therefore constructed a small plate about the size of a shilling, having a glass handle coated with sealing-wax, and when the large metal plate was scarcely able to affect an electrometer, he placed the small plate upon the inferior plane, and touched it with the edge of the large plate. He then removed the large plate, and upon presenting the small plate to the electrometer, the straws diverged to their utmost limits.

Sect. III. Cavallo's Condenser, or Collector of Electricity.

This instrument is represented in Plate CCXLIX. Fig. 16. where GHJKLX and NOPV, are two frames of wood, fastened to a wooden base by brass hinges, so that they can be either placed vertically, as in the Figure, or laid out in a horizontal position, so as to be supported on the table on which the instrument stands. The inner surfaces of these frames above their middle, are covered either with gilt paper, or with very flat tin plates. These two frames are kept in a vertical position, by means of two flat pieces of wood S and T, connected by a hook H. Between these two vertical frames there stands a flat tin plate, 15 inches long, and 8 inches broad, soldered to two tin tubes A, A, only one of which is seen in the Figure. These tin tubes, being supported by glass rods D, D, coated with sealing-wax, only one of which is seen. When the instrument is ready for use, as in the Figure, the surfaces of the gilt paper are parallel to the tin plate, but not in contact with it. An electrometer E is connected with one of the tin tubes A, A, while the other tin tube is connected by a wire with the body, whose electricity is to be condensed. When the tin plate apparatus has stood for a short time to accumulate the electricity, the hook H is loosened, and the wooden frames are thrown back into a horizontal position, and the electrometer will then diverge with the condensed electricity. The condensing power of this instrument increases with the proximity of the tin.
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Sect. IV. Cuthbertson's Condenser.

A vertical section of this condenser is shown in Plate CCXLIX. Fig. 17, where a and b are two flat and round brass plates, about six inches in diameter, and screwed tightly into the brass balls c, d. The ball d is fixed to the top of a brass pillar e, which has a joint at its lower extremity. The ball c is placed upon a glass pillar firmly fixed into the wooden box. The plate b can therefore be thrown back into the dotted position shown in the Figure. The insulated receiving plate a, being connected with a wire to the body whose electricity is to be condensed, remains in this state for some time. The wire is then removed. The plate b is thrown back into the dotted position, and the plate a is presented to an electrometer, as formerly.

Sect. V. Condensing Electrometer.

This instrument, represented in Plate CCXLIX. Fig. 18, is nothing more than the preceding condenser applied to an electrometer, the plate a of the condenser being fixed to the cap of the electrometer instead of the insulating stand c. When the plate a has received the electricity from the electrified body, the plate B is then drawn back round the joint h, and the electrometer instantly indicates the condensed electricity.

In order to increase the effect, Cuthbertson's condenser is sometimes used along with this instrument, the fixed plate of the former being connected with the fixed plate of the latter by a small brass pin.

Sect. VI. Simple Condenser proposed by Mr. Singer.

Mr. Singer has proposed to construct a very simple condenser, by placing three small spots of sealing wax, so as to form a triangle on the lower surface of the upper conductor of the electrophorus. These spots of wax serve as short insulating legs, by which the plate may be supported at the distance of about the twelfth of an inch from the surface of a smooth and even table. The plate is then connected, as formerly, with the electrified body; and, after some time, the connecting wire is removed; and the plate, when raised from the table, will exhibit the condensed electricity.

Sect. VII. Read's Condenser.

In this instrument, the fixed plate is placed horizontally on a vertical insulated stand, and the moveable plate is separated from it by turning a screw nut, and allowing it to descend to the bottom of the stand.

Sect. VIII. Nicholson's Spinning Condenser.

A vertical section of this ingenious instrument is represented in Plate CCXLIX. Fig. 19, where A is a metallic vase, having a long steel axis, which passes through a hole in the stand H at K, and rests with its pointed end upon an adjustable socket at C. The two shaded plates D and F are circular, and are made of glass, being nearly 1/4 inch in diameter, and 1/25 of an inch thick. The plate D is fixed to the vase A, and revolves along with it, while the plate H is fixed to the stand. Two metallic hooks F, G, are cemented opposite to each other, into holes drilled in the edge of the plate F; and into the upper plate are cemented two small tails of the fine flattened wire used in making silver lace. These tails are bent down, as shown in the Figure, so as to strike the hooks F, G during the revolution, but so as to be free from the rest of the apparatus. By means of the screw at C, the distance between the glass plates D, E may be increased or diminished. The two contiguous faces of the glass plates are coated, as shown in Fig. 20. Each of the tails communicates with the tinfoil coating of the plate D, and the hook H with that of the plate E; but the other hook G is completely insulated, and is intended to communicate only with the electrified body. The instrument being thus constructed, the moveable part of it, viz. the plate D, and all above it and the steel axis, is set a spinning by the action of the finger and thumb upon the top T. One of the tails will strike the hook G, connected with the electrified body, and will receive and communicate to the coating of the plate D some of its electricity. At the end of half a revolution, the tail touches the hook F, and electrifies it along with the upper coating, and the lower coating on the side of E. The tail proceeds, collecting more electricity from the hook G, and again deposits it at F, till there is so much condensed as is requisite to produce a divergency in the pitch ball electrometer suspended at F. Mr. Nicholson constructed an instrument of this kind five inches high, and found it capable of condensing very small degrees of electricity. See Nicholson's Journal, April 1797.


CHAP. III.

On Instruments for Doubling Electricity.

The instruments called Doulors, are those which are constructed in such a manner, that very small quantities of electricity may be continually doubled, till it becomes perceptible by the common electrometer. The first instrument of this kind was invented by the Rev. Abraham Bennet.

Sect. I. Description of Bennet's Doubler.

This instrument consists of two brass plates, which Bennet's we shall call A and B. The plate A has an insulating handle fixed in its centre, while the plate B has a similar handle fixed in its circumference. Excepting the upper side of A, all the sides of these plates are varnished. The third plate C is a plate of brass varnished on its upper side, and laid upon Bennet's gold-leaf electrometer.

The body, whose electricity is to be doubled, is applied to the under side of the plate C, which lies upon the electrometer, while B is touched with a finger of the other hand, and then removing the communication with the electrified body, B is lifted up by its insulating handle; and if the electricity is not now sensible by the electrometer, A is placed, by means of its insulating handle, upon B, thus elevated; then touching A, by stretching a finger over the juncture of its insulating handle, and again withdrawing the finger, A is
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Nicholson's doubler.

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is and represented sensibly fixed. These but lie. The plate B is then touched, by stretching a finger over the juncture of its insulating handle, and removing A, and then withdrawing the finger from B, and lifting it up from C, the electricity becomes doubled.

If the electricity is not sensible after duplication, Mr. Bennet proposes to repeat the operation 10 or 20 times, which, by doubling it every time, will render visible the smallest conceivable quantity of electricity, for at the end of the 20th operation it is augmented above 500,000 times. This operation, so often repeated, may appear tedious, yet when the art of performing it readily is acquired, it will not occupy 40 seconds. When it is required to elicit sparks, the plates must be placed upon amelectrometer, and the doubling repeated till the sparks are emitted.

In making the preceding experiments, great care must be taken not to excite any electricity by the friction of the finger upon the varnished side of the plate. In order to avoid this, Mr. Bennet joined to each of the plates a conducting handle of unbiased mahogany, by means of an insulating nut of baked wood, covered with sealing wax, so that he did not require to touch the sealing wax of the insulated nut, but occasionally to stretch a finger over it, to touch the plate, whilst the mahogany handle was held in the hand. Mr. Bennet likewise put thimbles on the ends of the touching fingers; but after every precaution, he still found that electricity was produced in the instrument without previous communication. See Phil. Trans. 1787, p. 288.

Sect. II. Darwin's Moveable Doubler.

In order to avoid the labour of the preceding operation, Dr. Darwin invented the moveable doubler, consisting of four metallic plates, which could be moved by a wheel worked into positions which required them to be touched by the hand, in order to produce the effect. This instrument was shown to Mr. Nicholson in December 1787, and it occurred to him that the whole of the operation might be performed by the rotation of a simple winch, and hence he was led to the construction of the following instrument.


This instrument is represented in Figs. 1 and 2 of Plate CCL. It is supported on a glass pillar 6½ inches long, and consists of two fixed plates of brass A, C, two inches in diameter, separately insulated, and placed in the same plane, so that a revolving plate B may pass near them without touching. A brass ball D, two inches in diameter, is fixed on the end of the axis that carries the plate B, and is loaded within at one side, to act as a counterpoise to the revolving plate B, so as to keep it at rest in any position. The axis PN is made of varnished glass, and so are the axes that join the three plates with the brass axis NO. The axis NO passes through the brass piece M, which supports the plates A and C. At one extremity of this axis is the ball D, and the other is connected with a rod of glass NP, upon which the handle L is fixed, and also the piece GH separately insulated. The pins E, F rise out of the back of the fixed plates A, C, at unequal distances from the axis. The piece K, is parallel to GI; and both of them have their ends armed with small pieces of harpsichord wire, that they may touch the pins F, E, in certain points of their revolution. In the piece M there is fixed a pin I, which intercepts a small wire proceeding from the revolving plate B. These wires are so adjusted by bending, that when the plate B is exactly opposite to D, the piece GI connects the two fixed plates, while the wire and pin at I form a connection between the ball D and the plate B. On the contrary, when the plate B is exactly opposite to the plate C, the ball D becomes connected with C, by the contact of F, with the wire at K, the plates A and B being then completely unconnected with any other part of the apparatus. In all other positions, the three plates and the ball will be perfectly unconnected with each other.

"When the plates A and B," says Mr. Nicholson, "are opposite to each other, the two fixed plates A and C may be considered as one mass; and the revolving plate B, together with the ball D, will constitute another mass. All the experiments yet made, concur to prove that these two masses will not possess the same electric state; but that, with respect to each other, their electricities will be plus and minus. These plates would be simple, and without any compensation, if the masses were remote from each other; but as that is not the case, a part of the redundant electricity will take the form of a charge in the opposed plates A and B. From other experiments, I find that the effect of the compensation on plates opposed to each other at the distance of one forty part of an inch, is such, that they require to produce a given intensity at least 100 times the quantity of electricity that would have produced it in either singly and apart. The redundant electricities in the masses under consideration, will therefore be unequally distributed: the plate A will have about 99 parts, and the plate C one; and, for the same reason, the revolving plate B will have 99 parts of the opposite electricity, and the ball D one. The rotation, by destroying the contacts, preserves this unequal distribution, and carries B from A to C, at the same time that the tail K connects the ball with the plate C. In this situation, the electricity in B acts upon that in C, and produces the contrary state, by virtue of the communication between C and the ball; which last must therefore acquire an electricity of the same kind with that of the revolving plate. But the rotation again destroys the contact, and restores B to its first situation opposite A. Here, if we attend to the effect of the whole revolution, we shall find that the electric states of the respective masses have been greatly increased; for the 99 parts in A and in B remain, and the one part of electricity in C has been increased so as nearly to compensate 99 parts of the opposite electricity in the revolving plate B, while the communication produced an equal mutation in the electricity of the ball. A second rotation will of course produce a proportional augmentation of these increased quantities, and a continuance of turning will soon bring the intensities to their maximum, which is limited by an explosion between the plates.

If one of the parts be connected with an electrometer, more especially that of Bennet, these effects will be very clearly seen. The spark is usually produced by a number of turns between 11 and 20; and the electrometer is sensibly acted upon by still fewer. When one of the parts is occasionally connected with the earth, or when the adjustment of the plates is altered, there are some variations in the effects not difficult to
be reduced to the general principles, but sufficiently curious to excite the meditations of persons the most experienced in this branch of natural philosophy.

If the ball be connected with the lower part of Ben- net's electrometer, and the plate A with the upper part, and any weak electricity be communicated to the electrometer, while the position of the apparatus is such that the cross piece GH touches the two pins, a very few turns will render it perceptible. But here, as well as in the common doubler, the effect is rendered uncertain, by the condition that the communicated electricity must be strong enough to destroy and predomi- nate over any other electricity the plates may possess. I scarcely need observe, that, if this difficulty should be hereafter removed, the instrument will have great advantages as a multiplier of electricity in the facility of its use, the very speedy manner of its operation, and the unequivocal nature of its results.” See Phil. Trans. 1788, p. 403.

Sect. IV. Bennet's Improvement upon his Doubler.

We have already seen, that Mr Bennet was aware, that electricity was produced in his doubler even when none had been previously communicated to it. In or- der to remedy this, he connected the plates A and C by a wire, having at its ends hooks, which went into two small knobs on the back of the plates, the pillar which supports the doubler being in contact with the middle of the same wire. Another wire connected the back of the plate B with the brass ball D. In this man- ner all the plates communicated with the ground, and by turning the winch, all its electricity could be dis- charged in every part of its revolution. Mr Bennet observed, that the spontaneous discharge of the doubler was always negative. With a phial positively charged he touched A and C, and turned the doubler till it pro- duced sparks for a long time together. He now hook- ed on the wires as formerly described, and made the plate B revolve about 100 times, which so completely deprived the doubler of its positive electricity, that, when the wires were taken off, it produced a negative charge at about the same number of revolutions which it formerly required. The phial positively charged was again applied, and the wires being again hooked upon the plates, B was made to revolve 50 times, which was found sufficient to deprive it of its positive charge. In many cases, five or six revolutions answered this purpose; but Mr Bennet generally allowed 40 or 50 turns of the handle.

Sect. V. Cavallo's Improvement upon Benne t's Doubler.

Mr Cavallo having found, that, after doubling 20 or 30 times, the doubler became strongly electrified although no electricity had been communicated to it, ima- gined that this electricity arose from some friction of the varnished plates. In order to avoid this source of electricity, he constructed three plates without the least varnish, and which stood within the eighth of an inch of each other. Each plate stood vertically, and was sup- ported by two glass sticks, which were coated with sealing-wax, and fixed on a wooden pedestal 7 1/2 inches long, 2 1/2 broad, and 1 1/2 thick. The vertical plate is about 8 inches in diameter, and is made of strong tin. The stand is so narrow, that it projects only a little be- yond the face of the tin plate, so as just to prevent the two faces from coming in contact when they are placed facing one another upon a table. The method of doubling with these plates is exactly the same as with Benet's doubler, only instead of placing the one upon the other, they are placed facing each other; and in performing the operations, they are held by the wooden stand, so that no friction can take place. Even with these precautions, however, Mr Cavallo candidly ac- knowledges that the plates still produced electricity from themselves, and that the instrument could not be depended upon. See Phil. Trans. 1788, vol. ixxxviii. page 1.

Sect. VI. Dr Robison's Improvement upon Bennet's Doubler.

Dr Robison was of opinion, that the instrument as originally constructed by Mr Bennet, might be freed from the error of producing electricity without communica- tions, by employing a plate of air as the intermedium between the three plates of the doubler. To effect this, he proposes to stick on one of the plates three small spherules, made from a capillary tube of glass, or from a fibre of melted sealing-wax. The other plate being made to rest on these three points, will be separated from the other by a plate of air, and will scarcely re- ceive any friction that will affect the results of the operation. Dr Robison was also of opinion, that if the fine wires, which form the connections in Nicholson's doubler, were tipped with little balls, the dissipation would be greatly prevented, and the instrument much improved. He likewise thinks, that an alternate motion like that of a pump handle might be advantageously used, as the plates would thus be permitted to approach each other face to face, and admit a greater multiplication, if it were thought necessary. See Robison's System of Mechanical Philosophy, vol. iv. now in the press.

fixed wire $N$, and of course renders the plate $B$ uninsulated. When the lever $KL$, however, begins to move towards $X$, the extremity $m$ of the wire $OM$ is withdrawn from $N$, and the plate $B$ remains insulated; and when the lever has reached the position $KX$ as far as it can go, the wire $m$ touches the plate $C$, so that the insulated plates $B$ and $C$ now communicate with each other.

When the plates $A$ and $B$ are together, as in the Figure, $A$ has its capacity for electricity increased by the presence of the uninsulated plate $B$, and therefore if any weakly electrified body is made to touch $A$, it will acquire a greater quantity of electricity from the contact than it would otherwise have done. Let us suppose that $A$ acquires a small quantity of positive electricity, then $B$ will acquire negative electricity.

On moving the lever $KL$, towards $X$, $B$ remains insulated and possessed of negative electricity. When $B$ touches $C$ by means of the wire $mO$, its negative electricity passes almost entirely to $C$, as the capacity of $C$ for electricity is greatly increased by the presence of the uninsulated plate $D$. If the plate $B$ is carried back to $A$, it will acquire a new quantity of negative electricity, which in a similar manner may be communicated to $C$. By a repetition of this process, the electricity will be multiplied or accumulated in $C$. The plate $D$ is drawn out from $C$ by means of the slider $FP$, and hence the capacity of $C$ for electricity will be much diminished. Consequently, if an electrometer be brought into contact with it, the negative electricity will be indicated by the divergency of the gold leaves. Mr Cavallo is of opinion, that the principal cause that renders this instrument certain in its effects, is, that all the residuum of electricity which can remain upon the plate $A$, after an experiment is performed, and after that plate is touched, is too inconsiderable to induce a contrary electricity in $B$, the electricity which is originally communicated to $A$ not being increased upon it in the course of the experiment. The drawing is about $\frac{1}{4}$ of the real size of the instrument. See Cavallo's Treatise on Electricity, 4th edit. vol. iii. p. 98, and his Elements of Natural Philosophy, vol. iii. p. 425-429.

BOOK V.

On Instruments for General Purposes.

Sect. I. On Kinnersley's Electrical Air Thermometer.

This instrument is represented in Plate CCL. Fig. 4, where $AB$ is a glass tube about 10 inches long and two inches in diameter, and made air tight at both ends by two brass caps. A small tube, $HA$, open at both ends, passes through a hole in the upper cap, and descends into some water at the bottom of the tube. The two hooked wires $FG, EI$, slide through the caps, so that the brass knobs $G, I$ can be set at any distance. This instrument is placed upon a wooden stand $CD$. If the knobs $G, I$ are brought into contact, and a charge sent through them, by connecting the hooks $E, F$ with the outside and inside of a Leyden jar, no effect will be produced; but if the knobs are separated, so that the charge is sent through the intervening mass of air, the air displaced and rarified will press upon the water at the bottom of the tube, and raise it almost to the top of the small tube $AH$; it will then sink a little, and will afterwards gradually subside into its first position.

Sect. II. Volta's Hydrogen Lamp.

The facility with which hydrogen gas is inflamed, Volta's hydrogen lamp. A quantity of hydrogen gas is put into a reservoir, and, by means of the pressure of a column of water, the gas is allowed to escape from a small aperture by turning a stop-cock. An electrophorus is placed in a box below this reservoir, and a wire passes through a glass tube from the upper part of the box to the small aperture. The cover of the electrophorus being connected by a silk cord with the handle of the stop-cock, is raised when the cock is opened, and the spark from this cover is conveyed by the insulated wire to the stream of gas, which instantly kindles, so that a candle may be immediately lighted. As only a small quantity of the gas is consumed, a light may be procured above a hundred times before all the gas in the reservoir is exhausted.

Sect. III. Volta's Electric Pistol.

This instrument consists of a brass vessel, of an oblong spheroidal form, pierced at its two vertices. Into one of these openings, a glass tube of the same diameter is introduced, which projects about four inches beyond the vessel, and is continued nearly to the middle of the cavity. A metallic stem passes through this tube, the outer end of which carries a brass ball, while the other end extends beyond the inner extremity of the tube. Through the other aperture in the spheroidal vessel, is introduced an equal mixture of inflammable gas and atmospheric air, and the aperture is then closed by a cork. The vessel is now taken in the hand, by the middle of its convexity, and a spark sent from the prime conductor to the metallic ball, will instantly inflame the gas, and drive out the cork with a smart explosion.

PART III. THEORETICAL ELECTRICITY.

CHAP. I.

On the Theories of Electricity before the time of Epinicus and Cavendish.

In our History of Electricity, we have already given a sufficiently full account of the crude hypotheses of Cabaneus, Descartes, and Boyle; of the more rational views of Dufay, Nollet, Symmers, and Ellicott; and of theories prior to those of Epinicus and Cavendish.
ELECTRICITY.

The admirable hypothesis of negative and positive electricity advanced by Dr Franklin, which afterwards formed the groundwork of the more perfect theories of Epininus and Cavendish.

To enter into any farther details upon these hypotheses, would be to waste the time without adding to the information of the reader.

The late Professor Russel, who filled the chair of Natural Philosophy in the University of Edinburgh with distinguished ability, endeavoured to explain the phenomena of electricity, by a substance which he called the electrical fluid, which was connected with bodies by attractive and repulsive forces, diminishing as the distance increases. He considered the electrical fluid as a compound fluid, containing elementary fire, and deriving from it a high degree of elasticity, or a mutual repulsion of its parts. This repulsive force, however, acts at a distance; and hence bodies containing more electric fluid than the spaces around them, repel each other. The principal ingredient of the compound fluid is electricity, which is united with the elastic fluid by chemical affinity or elective attraction. This attraction extends to all distances, but diminishes according to a law different from that of the mutual repulsion of the elastic fluid; and its general tendency is to repress these repulsions when the fluid exists in its compound state. Conducting bodies are attracted by the electricity at all distances, but it attracts electrics only at insensible distances, and at such distances its own particles attract each other. This complex theory, in which the forces are all accommodated to the phenomena, though proposed merely as a conjecture by its ingenious author, was received at the time with great satisfaction, and accorded pretty well with the common electrical phenomena.

A hypothesis somewhat similar to that of Professor Russel, was proposed by a celebrated and able naturalist, M. de Luc. Having had occasion to read Volta's theory of electric influences, De Luc was struck with the resemblance between the phenomena of the electrophorus, and the hygroscopic phenomena of the condensation and evaporation of moisture; and by a more extensive examination, he observed a striking analogy between all the other phenomena of electricity and hygroscopy. He was therefore led to refer all the phenomena of electricity to the operation of a compound expansive substance, called the electric fluid. This fluid he supposed to consist first of electric matter, which is the gravitating part of the compound, and of the electric deferent fluid, or carrying fluid, by which the electric matter was conveyed from one body to another. We cannot occupy the attention of the reader with any farther account of this theory. Those who think it worth their while to pursue it farther, will find it fully detailed in De Luc's Idées sur Meteorology, § 206; or a general view of it in Dr Robison's System of Mechanical Philosophy, vol. iv. where an account of Professor Russel's hypothesis will also be found. See also Nicholson's Journal, vol. xxviii. p. 3, for some recent observations of De Luc respecting his own theory.

SECTION I.

Cavendish's Hypothesis.

The electric fluid is a substance, the particles of which repel each other, and attract the particles of all other matter, with a force inversely as the square of the distance.

The particles of all other matter also repel each other, and attract those of the electric fluid, with a force varying according to the same law. Or, if we consider the electric fluid as matter different from all other matter, the particles of all matter, both those of the electric fluid, and of other matter, repel particles of the same kind, and attract those of a contrary kind, with a force inversely as the square of the distance. * Mr Cavendish never comprehends the electric fluid under the general term matter, but considers it only as another sort of matter. He regards it as indifferent whether all sorts of matter are supposed to possess in an equal degree the attraction and repulsion described in the hypothesis, or whether some sorts only are supposed to possess it in a greater degree than others. It is probable, however, that the electric fluid possesses this property in a much greater degree than any other matter; for its weight in any body probably bears a very small proportion to the weight of the matter in the body, but yet the force with which the electric fluid in any body attracts any particle of matter in that body, must be equal to the force with which the matter of the body repels that particle, otherwise the body would appear electrical, as will afterwards appear.

In order to explain this hypothesis more fully, Mr Cavendish supposes that one grain of electric fluid attracts a particle of matter at a given distance, with as much force as four grains, (or any other number,) of any matter, such as lead, for example, repel it; then one grain of electric fluid will repel a particle of electric fluid already been sufficiently detailed in our History of Electricity. The two theories, in which all the phenomena are explained by the agency of a single fluid, are essentially the same, and were framed without any communication between these two philosophers. Epininus, however, having published his theory about ten years before that of Cavendish appeared, has justly received the credit of the invention; and even in this country, his name has been alone associated with the theory which he formed. The justice of this decision we are neither disposed nor entitled to question; but the claims of Mr Cavendish, as a second inventor, have scarcely in his own country received due attention, while on the continent, his name is almost never mentioned by those illustrious men, who have cultivated and extended the science of electricity since the publication of his valuable researches.

We trust, therefore, that we are doing an act of justice to the memory of that distinguished philosopher, as well as a service to science, in giving, almost in his own words, a full account of his theory, which has never yet appeared in any work but the Philosophical Transactions, in which it was at first published. The hypothesis of Epininus has already been more than once published in our own language; and such of our readers as wish to see a full and able abridgment of it, are referred to the fourth volume of Dr Robison's System of Mechanical Philosophy.

SECTION II.

Theory of Epininus and Cavendish.

The circumstances under which the theories of Epininus and Cavendish were laid before the public, have al-

* In Mr Cavendish's own statement of his hypothesis, he characterises the electric force as a force varying, inversely, as some less power of the distance than the cube; but as the real law of action has been ascertained, (see page 410,) we have substituted it in the text.
ELECTRICITY.

The electric fluid, with as much force as four grains of lead attract it, and one grain of electric fluid will repel one grain of electric fluid, with as much force as four grains of lead will repel four grains of lead.

All bodies in their natural state, with regard to electricity, contain such a quantity of electric fluid, interspersed between their particles, that the attraction of the electric fluid, in any small part of the body, on a given particle of matter, shall be equal to the repulsion of the matter, in the same small part on the same particle. When a body is in this state, Mr. Cavendish calls it saturated with electric fluid; when the body contains more than this quantity of electric fluid, he calls it overcharged, and when it contains less, he calls it undercharged.

Lemma 1. Let \( EA \) (Plate CCL. Fig. 1.) represent a cone continued infinitely; let \( A \) be the vertex, and \( Bb \) and \( Dd \) planes parallel to the base; and let the cone be filled with uniform matter, whose particles repel each other with a force inversely as the \( n \) power of the distance. If \( n \) is greater than 3, the force with which a particle at \( A \) is repelled by \( E B b \), or all that part of the cone beyond \( Bb \) is as \( \frac{1}{AB^n} \). For supposing \( AB \) to flow, the fluxion of \( EB b \) is proportional to \(-AB \times AB^3 \), and the fluxion of its repulsion on \( A \) is proportional to \( \frac{AB}{AB^n} \); the flux of which is

\[
\frac{1}{n-3 \times AB^n-1};
\]

which when \( AB \) is infinite is equal to nothing; consequently the repulsion of \( EB b \) is proportional to

\[
\frac{1}{n-3 \times AB^n-1} \quad \text{or to} \quad \frac{AB^n}{1}.
\]

Corol. If \( AB \) is infinitely small, \( \frac{1}{AB^n} \) is infinitely great; therefore the repulsion of that part of the cone between \( A \) and \( Bb \), on \( A \), is infinitely greater than the repulsion of all that beyond it.

Lemma 2. By the same method of reasoning it appears, that if \( n \) is equal to 3, the repulsion of the matter between \( Bb \) and \( Dd \) on a particle at \( A \), is proportional to the logarithm of \( \frac{AD}{AB} \); consequently, the repulsion of that part is infinitely small in respect of that between \( A \) and \( Bb \), and also infinitely small in respect of that beyond \( Dd \).

Lemma 3. In like manner, if \( n \) is less than 3, the repulsion of the part between \( A \) and \( Bb \) on \( A \) is proportional to \( AB^{n-1} \); consequently, the repulsion of the matter between \( A \) and \( Bb \), on \( A \), is infinitely small in respect of that beyond \( Bb \).

Definition. If the electric fluid in any body is by any means confined in such a manner that it cannot move from one part of the body to the other, it is called immovable: if it is able to move readily from one part to another, it is called moveable.

Prop. 1. A body overcharged with electric fluid attracts or repels a particle of matter or fluid, and is attracted or repelled by it, with exactly the same force as it would, if the matter in it, together with so much of the fluid as is sufficient to saturate it, was taken away, or as if the body consisted only of the redundant fluid in it. In like manner an undercharged body attracts or repels with the same force, as if it consisted only of the redundant matter; the electric fluid, together with so much of the matter as is sufficient to saturate it, being taken away. This is evident from the definition of saturation.

Prop. II. Two over or under charged bodies attract or repel each other with just the same force that they would, if each body consisted only of the redundant fluid in it, if overcharged, or of the redundant matter in it, if undercharged. For, let the two bodies be called \( A \) and \( B \); by the last proposition, the redundant substance in \( B \) impels each particle of fluid and matter in \( A \), and consequently impels the whole body \( A \), with the same force that the whole body \( B \) impels it: for the same reason, the redundant substance in \( A \) impels the redundant substance in \( B \); with the same force that the whole body \( A \) impels it. It is shown, therefore, that the whole body \( B \) impels the whole body \( A \), with the same force that the redundant substance in \( B \) impels the whole body \( A \), or with which the whole body \( A \) impels the redundant substance in \( B \); and that the whole body \( A \) impels the redundant substance in \( B \) with the same force that the redundant substance in \( A \) impels the redundant substance in \( B \). Therefore the whole body \( B \) impels the whole body \( A \), with the same force with which the redundant substance in \( A \) impels the redundant substance in \( B \), or with which the redundant substance in \( B \) impels the redundant substance in \( A \).

Corol. Let the matter in all the rest of space, except in two given bodies, be saturated with immovable fluid; and let the fluid in those two bodies be also immovable. Then, if one of the bodies is saturated, and the other either over or under charged, they will not at all attract or repel each other. If the bodies are both overcharged, they will repel each other. If they are both undercharged, they will also repel each other. If one is overcharged and the other undercharged, they will attract each other.

\( N. B. \) In this corollary it is understood that a body overcharged is overcharged in all parts, or at least no where undercharged; in like manner, that a body undercharged is undercharged in all parts, or at least no where overcharged.

Prop. III. If all the bodies in the universe are saturated with electric fluid, it is plain that no part of the fluid can have any tendency to move.

Prop. IV. If the quantity of electric fluid in the universe is exactly sufficient to saturate the matter therein, but unequally dispersed, so that some bodies are overcharged and others undercharged; then, if the electric fluid is not confined, it will immediately move till all the bodies in the universe are saturated, for, supposing that any body is overcharged, and the bodies near it are not, a particle at the surface of that body will be repelled from it by the redundant fluid within; consequently some fluid will run out of that body; but if the body is undercharged, a particle at its surface will be attracted towards the body by the redundant matter within, so that some fluid will run into the body.

Lemma 4. Let \( BDE, bde, \) and \( \beta \delta \), (Fig. 2.) be concentric spherical surfaces, whose centre is \( C \); if the space \( B\delta \) is filled with uniform matter, whose particles Fig. 2. repel with a force inversely as the square of the distance; a particle placed any where within the space \( CB \), as at \( P \), will be repelled with as much force in one direction between the spherical surfaces \( BDE \) and \( bde \), or between \( BDE \) and

* By the space \( B\delta \) or \( \beta \delta \) is meant the space comprehended and \( \beta \delta \); by the space \( CB \) or \( C\delta \), is meant the spheres \( bde \) or \( \beta \delta \).
as another, or it will not be impelled in any direction.
This is demonstrated in Newt. Princip. lib. i. prop. 70.

Lemma 5. If the repulsion is inversely as the square of the distance, a particle placed anywhere without the sphere BDE, is repelled by that sphere, and also by the space Bb, with the same force that it would if all the matter therein was collected in the centre of the sphere; provided the density of the matter in it is everywhere the same at the same distance from the centre. This is easily deduced from Prop. 71. of the same book, and has been demonstrated by other authors.

Prop. V. Prob. 1. Let the sphere BDE be filled with uniform solid matter, overcharged with electric fluid; let the fluid in it be moveable, but unable to escape from it; let the fluid in the rest of infinite space be moveable, and sufficient to saturate the matter in it; and let the matter in the whole of infinite space, or at least in the space Bb, whose dimensions will be given below, be uniform and solid; and let the law of the electric attraction and repulsion be inversely as the square of the distance; it is required to determine in what manner the fluid will be disposed both within and without the globe.

Take the space Bb such that the interstices between the particles of matter in it shall be just sufficient to hold a quantity of electric fluid, whose particles are pressed close together, so as to touch each other, equal to the whole redundant fluid in the globe, besides the quantity requisite to saturate the matter in Bb; and take the space Bb such that the matter in it shall be just able to saturate the redundant fluid in the globe; then, in all parts of the space Bb, the fluid will be pressed close together, so that its particles shall touch each other; the space Bb will be entirely deprived of fluid; and in the space Cb, and all the rest of infinite space, the matter will be exactly saturated.

For, if the fluid is disposed in the above mentioned manner, a particle of fluid placed anywhere within the space Cb will not be impelled in any direction by the fluid in Bb, or the matter in Bb, and will therefore have no tendency to move. A particle placed anywhere without the space Bb will be attracted with just as much force by the matter in Bb, as it is repelled by the redundant fluid in Bb, and will therefore have no tendency to move. A particle placed anywhere within the space Bb, will indeed be repelled towards the surface, by all the redundant fluid in that space which is placed nearer the centre than itself; but as the fluid in that space is already pressed as close together as possible, it will not have any tendency to move; and in the space Bb there is no fluid to move, so that no part of the fluid can have any tendency to move.

Besides, it seems impossible for the fluid to be at rest, if it is disposed in any other form; for if the density of the fluid is not everywhere the same at the same distance from the centre, but is greater near b than near d, a particle placed anywhere between these two points will move from b towards d; but if the density is everywhere the same at the same distance from the centre, and the fluid in Bb is not pressed close together, the space Cb will be overcharged, and consequently a particle at a will be repelled from the centre, and cannot be at rest. In like manner, if there is any fluid in Bb, it cannot be at rest. And, by the same kind of reasoning, it might be shown, that, if the fluid is not spread uniformly within the space Cb, and without the sphere Bb, it cannot be at rest.

Corol. 1. If the globe BDE is undercharged, every thing else being the same as before, there will be a space Bb, in which the matter will be entirely deprived of fluid, and a space Bb, in which the fluid will be pressed close together; the matter in Bb being equal to the whole redundant matter in the globe, and the redundant fluid in Bb, being just sufficient to saturate the matter in Bb; and in all the rest of space the matter will be exactly saturated. The demonstration is exactly similar to the foregoing.

Corol. 2. The fluid in the globe BDE will be disposed in exactly the same manner, whether the fluid without is immovable, and disposed in such a manner that the matter shall be everywhere saturated, or whether it is disposed as above described; and the fluid without the globe will be disposed in just the same manner, whether the fluid within is disposed uniformly, or whether it is disposed as above described.

Lemma 6. Let the whole space comprehended between two parallel planes, infinitely extended each way, be filled with uniform matter, the repulsion of whose particles is inversely as the square of the distance; the plate of matter formed thereby will repel a particle of matter with exactly the same force, at whatever distance from it, it be placed.

For, suppose that there are two such plates, of equal thickness, placed parallel to each other, let A (Fig. 3.) be any point not placed in or between the two plates; let BCD represent any part of the nearest plate; draw the lines AB, AC, and AD, cutting the farthest plate in b, c, and d; for it is plain, that if they cut one plate, they must, if produced, cut the other; the triangle BCD is to the triangle bcd, as AB to AB; therefore, a particle of matter at A will be repelled with the same force by the matter in the triangle BCD, as by that in bcd. Whence it appears, that a particle at A will be repelled with as much force by the nearest plate, as by the more distant; and consequently will be impelled with the same force by either plate, at whatever distance from it, it be placed.

Prop. VI. Prob. 2. In Fig. 4, let the parallel lines AC, Bb, &c. represent parallel planes infinitely extended each way; let the spaces AD and EH be filled with uniform solid matter; let the electric fluid in each of those spaces be moveable and unable to escape; and let all the rest of the matter in the universe be saturated with immovable fluid; and let the electric attraction and repulsion be inversely as the square of the distance. It is required to determine in what manner the fluid will be disposed in the spaces AD and EH, according as one or both of them are over and under charged.

Let AD be that space which contains the greatest quantity of redundant fluid, if both spaces are overcharged, or which contains the least redundant matter, if both are undercharged; or, if one is overcharged, and the other undercharged, let AD be the overcharged one. Then, first, there will be two spaces, AB and GH, which will either be entirely deprived of fluid, or in which the particles will be pressed close together; namely, if the whole quantity of fluid in AD and EH together, is less than sufficient to saturate the matter therein, they will be entirely deprived of fluid, the quantity of redundant matter in each being half the whole redundant matter in AD and EH together; but if the fluid in AD and EH together is more than sufficient to saturate the matter, the fluid in AB and GH
The force with which it does so, is that with which the redundant fluid in CD is attracted by the matter in EF.

Corol. 3. If AD is overcharged, and EH undercharged, and the redundant fluid in AD is exactly sufficient to saturate the redundant matter in EH, all the redundant fluid in AD will be collected in the space CD, where it will be pressed close together: the space EF will be entirely deprived of fluid, the quantity of matter in it being just sufficient to saturate the redundant fluid in CD, and the spaces AC and EH will be every where saturated. Besides, if an opening is made in the planes AA or HH, the fluid within the spaces AD or EH will have no tendency to run out at it, nor will the fluid on the outside have any tendency to run in at it: a particle of fluid too placed any where on the outside of both spaces, as at F, will not be at all attracted or repelled by these spaces, any more than if they were both saturated; but a particle placed anywhere between these spaces, as at S, will be repelled from d towards c; and if a communication was made between the two spaces, by the canal de, the fluid would run out of AD into EH, till they were both saturated.

In the following propositions, the bodies are supposed to consist of solid matter, confined to the same spot, so as not to be able to alter its shape or situation by the attraction or repulsion of other bodies on it; the electric fluid in these bodies is supposed to be moveable, but unable to escape, unless when otherwise expressed. As for the matter in all the rest of the universe, it is supposed to be saturated with immovable fluid. The electric attraction and repulsion is supposed to be inversely as any power of the distance less than the cube, except when otherwise expressed.

By a canal, he means a slender thread of matter, of such kind that the electric fluid shall be able to move readily along it, but shall not be able to escape from it, except at the ends, where it communicates with other bodies. Thus when he says that two bodies communicate with each other by a canal, he means that the fluid shall be able to pass readily from one body to the other by that canal.

Prop. VIII. If any body, at a distance from any over or under charged body, be overcharged, the fluid within it will be lodged in greater quantity near the surface of the body than near the centre. For, if you suppose it to be spread uniformly all over the body, a particle of fluid in it, near the surface, will be repelled towards the surface by a greater quantity of fluid than that by which it is repelled from it; consequently the fluid will flow towards the surface, and make it denser there: moreover, the particles of fluid close to the surface will be pressed close together; for otherwise, a particle placed so near it, that the quantity of redundant fluid between it and the surface should be very small, would move towards it; as the small quantity of redundant fluid between it and the surface would be unable to balance the repulsion of that on the other side.

From the two problems, it seems likely, that almost all the redundant fluid in the body will be lodged close to the surface, and there pressed close together, and the rest of the body will be saturated.

Corol. If the body is undercharged, the deficiency of fluid will be greater near the surface than near the centre, and the matter near the surface will be entirely deprived of fluid. It is likely, too, that all parts, except near the surface, will be saturated.

Prop. VIII. Let the bodies A and D (Fig. 5.) communicate with each other by the canal EF; and let one
of them, as D, be overcharged; the other body A will be so also. For as the fluid in the canal is repelled by the redundant fluid in D, it is plain, that unless A was overcharged, so as to balance that repulsion, the fluid would run out of D into A. In like manner, if one is overcharged, the other must be so also, to compensate the repulsion of B; but as the leg Np in is nearer than the other, the repulsion of B on the fluid in it will be greater; consequently some fluid will run out of A into D, on the same principle that water is drawn out of a vessel through a syphon: but if the repulsion of B on the fluid in the canal is so great, as to drive all the fluid out of the space GPHp (so that the fluid in the leg MGpn does not join to that in N Ip, then it is plain that no fluid can run out of A into D, any more than water will run out of a vessel through a syphon, if the height of the bend of the syphon above the water in the vessel is greater than that to which water will rise in vacuo.

Corol. If B is made undercharged, some fluid will run out of D into A, and that the attraction of B on the fluid in the canal is ever so great.

Prop. XII. Let ABC (Fig. 8) be a body overcharged with immovable fluid uniformly spread; let the bodies near ABC on the outside be saturated with immovable fluid, and let D be a body inclosed within ABC, and communicating by the canal DG with other distant bodies saturated with fluid; and let the fluid in D, and the canal and those bodies be movable; then will the body D be rendered undercharged.

For let us first suppose that D and the canal are saturated, and that D is nearer to B than to the opposite part of the body C; then will all the fluid in the canal be repelled from C by the redundant fluid in ABC; but if D is nearer to C than to B, take the point F, such that a particle placed there would be repelled from C with as much force, as one at D is repelled towards C; the fluid in DF, taking the whole together, will be repelled with as much force in one way as the other, and the fluid in FG is all of it repelled from C; therefore, in both cases, the fluid in the canal, taking the whole together, is repelled from C; consequently some fluid will run out of D and the canal, till the attraction of the unsaturated matter there is sufficient to balance the repulsion of the redundant fluid in ABC.

Prop. XIII. If we now suppose that the fluid in the outside of ABC is movable, the matter adjacent to ABC on the outside will become undercharged. There is no reason, however, to think, that that will prevent the body D from being undercharged; but it is not easy to say exactly what effect it will have, except when ABC is spherical, and the repulsion is inversely as the square of the distance. In this case, it appears by the last proposition, that the fluid in the part DB of the canal will be repelled from C, with just as much force as in the last proposition; but the fluid in the part DG will not be repelled at all: consequently D will be undercharged, but not so much as in the last proposition.

Corol. If ABC is now supposed to be undercharged, it is certain that D will be overcharged, provided the matter near ABC on the outside is saturated with immovable fluid; and there is great reason to think that it will be so, though the fluid in that matter is movable.
joining to the plane AB, in which the fluid will be pressed close together; and the fluid in that space will press against the plane AB, and will endeavour to escape from it; and by Prop. 2. the two bodies will attract each other; then the force with which the fluid presses against the plane AB, is very nearly the same with which the two bodies attract each other in the direction EA, provided that no part of AEFB is undercharged.

Suppose so much of the fluid in each part of the cylinder, as is sufficient to saturate the matter in that part, to become solid, the remainder, or the redundant fluid, remaining fluid as before. In this case, the pressure against the plane AB must be exactly equal to that with which the two bodies attract each other in the direction EA; for the force with which D attracts that part of the fluid which we supposed to become solid, is exactly equal to that with which it repels the matter in the cylinder; and the redundant fluid in EabF is at liberty to move, if it had any tendency to do so, without moving the cylinder; so that the only thing which has any tendency to impel the cylinder in the direction EA, is the pressure of the redundant fluid in AabB against AB; and as the part near EF is saturated, there is no redundant fluid to press against the plane EF, and thus to counteract the pressure against AB. Suppose now all the electric fluid in the cylinder to become fluid, the force with which the two bodies attract each other will remain exactly the same; and the only alteration in the pressure against AB will be, that part of the fluid in AabB, which we at first supposed solid and unable to press against the plane, will now be at liberty to press against it; but as the density of the fluid, when its particles are pressed close together, may be supposed many times greater than when it is not denser than sufficient to saturate the matter in the cylinder, and consequently the quantity of redundant fluid in AabB many times greater than that which is required to saturate the matter in it, it follows that the pressure against AB will be very little more than on the first supposition.

N.B. If any part of the cylinder is undercharged, the pressure against AB is greater than the force with which the bodies attract. If the electric repulsion is inversely as the square or some higher power of the distance, it seems very unlikely that any part of the cylinder should be undercharged.

Lemma 7. Let AB (Fig. 10.) represent an infinitely thin flat circular plate, seen edgewise, so as to appear to the eye as a straight line; let C be the centre of the circle; and let DC, passing through C, be perpendicular to the plane of the plate; and let the plate be of uniform thickness, and consist of uniform matter, whose particles repel with a force inversely as the n power of the distance; n being greater than 1, and less than 3: the repulsion of the plate on a particle at D, is proportional to \( DC^{\frac{n-1}{n}} \times DA^{-1} \), provided the thickness of the plate and size of the particle D is given.

For if CA is supposed to flow, the corresponding fluxion of the quantity of matter in the plate, is proportional to \( CA \times CA \times \frac{DC}{DA} \times DA \); and the corresponding fluxion of the repulsion of the plate on the particle D, in the direction DC, is proportional to \( \frac{CA \times CA \times DC}{DA \times DA} = DA \times DA \); for \( DA \) is to \( CA : CA : DA \), the variable part of the fluent of which is \( DC^{\frac{n-1}{n}} \).

whence the repulsion of the plate on the particle D, is proportional to

\[
\frac{DC}{n-1 \times DA^{n-1}} \quad \text{or to} \quad \frac{DC}{DA^{n-1}}
\]

Corol. If \( DC^{-1} \) is very small in respect of \( CA^{n-1} \), the particle D is repelled with very nearly the same force as if the diameter of the plate was infinite.

Lemma 8. Let L and l represent the two legs of a right angled triangle, and \( h \) the hypothenuse; if the shorter leg \( l \) is so much less than the other, that \( 2l^2 \) is very small in respect of \( L^2 \), then \( h^2 - l^2 = h\cdot l \) will be very small in respect of \( L^2 \).

For \( h^2 - l^2 = (l^2 + l^2)^{\frac{1}{2}} = l^2 \times \left(1 + \frac{l^2}{2l^2}\right) = \frac{3n-1}{2l^2} - \frac{3n-1}{2l^2} \\
\therefore h^2 - l^2 = \frac{3n-1}{2l^2} - \frac{3n-1}{2l^2} \\
\therefore \frac{1}{2L^2} = \frac{3n-1}{2l^2} - \frac{3n-1}{2l^2} \\
\frac{1}{2L^2} = \frac{3n-1}{2l^2} - \frac{3n-1}{2l^2} \\
& c. which is very small in respect of \( L^2 \), as \( L^2 \) is by the supposition very small in respect of \( l^2 \).

Corol. If \( AC = \frac{1}{2} \), the point E be taken in DC, such that EC = \( \frac{1}{2} \), the repulsion of the plate on it is very nearly the same as if the column was infinitely continued. For, by lemma 8, \( AC = \frac{1}{2} + DC = \frac{1}{2} + DA = \frac{1}{2} \), supposing the thickness of the plate and base of the column to be given. For if DC is supposed to flow, the corresponding fluxion of the repulsion is proportional to \( \frac{DC \times DC \times DC}{DA \times DA \times DA} \); the fluent of which, \( \frac{3n-1}{2} \), vanishes when DC vanishes.

Corol. 1. If the length of the column is so great, that \( AC = \frac{1}{2} \), is very small in respect of \( DC = \frac{1}{2} \), the repulsion of the plate on it is very nearly the same as if the column was infinitely continued. For, by lemma 8, \( AC = \frac{1}{2} + DC = \frac{1}{2} + DA = \frac{1}{2} \), supposing the thickness of the plate and base of the column to be given. For if DC is supposed to flow, the corresponding fluxion of the repulsion is proportional to \( \frac{DC \times DC \times DC}{DA \times DA \times DA} \); the fluent of which, \( AC = \frac{1}{2} \), vanishes.

Corol. 2. If \( AC = \frac{1}{2} \), is very small in respect of \( DC = \frac{1}{2} \), and the point E be taken in DC, such that EC = \( \frac{1}{2} \), shall be very small in respect of \( AC = \frac{1}{2} \), the repulsion of the plate on the small part of the column EC, to its repulsion on the whole column DC, very nearly as \( EC = \frac{1}{2} \) to \( AC = \frac{1}{2} \).

Lemma 10. If we now suppose all the matter of the plate to be collected in the circumference of the circle, so as to form an infinitely slender uniform ring, its repulsion on the column DC will be less than when the matter is spread uniformly all over the plate in the ratio of \( \frac{3n-1}{2} \times AC \times \left(\frac{1}{AC^{n-1}} - \frac{1}{DA^{n-1}}\right) \) to \( DC = \frac{1}{2} - DA = \frac{1}{2} \).

For it was before said, that if the matter of the plate be spread uniformly, its repulsion on the column will be proportional to \( DC = \frac{1}{2} + AC = \frac{1}{2} + DA \), or may be expressed by it; let now \( AC \), the semidiameter of the plate, be increased by the infinitely small quantity \( AC \); the quantity of matter in the plate will be increased by a quantity, which is to the whole as \( 2AC \) to \( AC \); and the repulsion of the plate on the column will be increa-
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Plate CCL. Fig. 10.

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By the fluid being disposed in a similar manner in both bodies, it is meant that the quantity of redundant or deficient fluid, in any small part of one body, is to that in the corresponding small part of the other, as the whole quantity of redundant or deficient fluid in one body, to that in the other. By the quantity of deficient fluid in a body, it is meant the quantity of fluid wanting to saturate it. This expression is used, in order to avoid confusion.

The fluxion of the fluid is equal to the fluxion of the fluid of the same quantity of matter collected in the point F, on the same column.

For the repulsion of the plate on the column in the direction CD, is the same whether the matter of it be collected in the whole circumference, or in the point A. Suppose it therefore to be collected in A, and let an equal quantity of matter be collected in F; take FG constantly equal to AD, and let AD and FG flow; the fluxion of CD is to the fluxion of FG, as AD to CD; and the repulsion of A on the point D, in the direction CD, is to the repulsion of F on G, as CD to AD; therefore the fluxion of the repulsion of A on the column CD, in the direction CD, is equal to the fluxion of the repulsion of F on CD; and when AD equals AC, the repulsion of both A and F on their respective columns vanishes; and therefore the repulsion of A on the whole column CD, equals that of F on CD; and when CD and CG are both infinitely extended, they may be considered as the same column.

Prop. XV. Let two similar bodies, of different sizes, and consisting of different sorts of matter, be both overcharged, or both undercharged, but in different degrees; and let the redundance or deficiency of fluid in each be very small, in respect of the whole quantity of fluid in them: it is impossible for the fluid to be disposed accurately in a similar manner in both of them; as it has been shown that there will be a space, close to the surface, which will either be as full of fluid as it can hold, or will be entirely deprived of fluid; but it will be disposed as nearly in a similar manner in both as is possible. To explain this, let BDE and bde, Fig. 12, be the two similar bodies; and let the space comprehended between the surfaces BDE and FGH (or the space BF as it may be called for shortness) be that part of BDE, which is either as full of fluid as it can hold, or entirely deprived of it: draw the surface sgh, such that the space sgh, shall be to the space BF, as the quantity of redundant or deficient fluid in bde, to that in BDE, and that the thickness of the space sgh shall everywhere bear the same proportion to the corresponding thickness of BF, then will the space sgh be either as full of fluid as it can hold, or entirely deprived of it; and the fluid within the space sgh will be disposed very nearly similarly to that in the space FGH.

For it is plain, that if the fluid could be disposed accurately in a similar manner in both bodies, the fluid would be in equilibrio in one body, if it was in the fluid; therefore draw the surface sgh such that the thickness of the space sgh shall be to every where proportional to the corresponding thickness of BF, as the diameter of bde to the diameter of BDE; and let the redundant fluid or matter in sgh be spread uniformly over the space sgh; then if the fluid in the space sgh is disposed exactly similarly to that in FGH, it will be in equilibrio; as the fluid will then be disposed exactly similarly in the spaces sgh and BDE; but as, by the supposition, the thickness of the space sgh is very small in respect of the diameter of bde, the fluid or matter in the space sgh will exert very nearly the same force on the rest of the fluid, whether it is spread over the space sgh, or whether it is collected in sgh.

Prop. XVI. Let two bodies, B and b, be connected to each other by a canal of any kind, and be either over or under charged: it is plain that the quantity of
be connected by the very slender cylindrical or prismatic canal \( \alpha \), filled with incompressible fluid, in the same manner as described in the preceding proposition: let the bodies be overcharged; but let the quantity of redundant fluid in each bear so small a proportion to the whole, that the fluid may be considered as disposed in a similar manner in both; let the bodies also be similarly situated in respect of the canal \( \alpha \); and let them be placed at an infinite distance from each other, or at so great a one, that the repulsion of either body on the fluid in the canal, shall not be sensibly less than if they were at an infinite distance; then, if the electric attraction and repulsion is inversely as the \( n \) power of the distance, \( n \) being greater than 1, and less than 3, the quantity of redundant fluid in the two bodies will be to each other, as the \( n-1 \) power of their corresponding diameters \( \alpha \) and \( \alpha \).

For if the quantity of redundant fluid in the two bodies is in this proportion, the repulsion of one body on the fluid in the canal, will be equal to that of the other body on it, in the contrary direction; and consequently the fluid will have no tendency to flow from one body to the other, as may thus be proved. Take the points \( D \) and \( E \) very near to each other; and take \( d \), \( a \) to \( D \), \( a \) to \( E \), as \( \alpha \) to \( \alpha \); the repulsion of the body \( B \) on a particle at \( D \), will be to the repulsion of \( B \) on a particle at \( d \), as \( \frac{1}{\alpha} \) to \( \frac{1}{\alpha} \); for, as the fluid is disposed similarly in both bodies, the quantity of fluid in any small part of \( B \), is to the quantity in the corresponding part of \( b \), as \( \frac{AF}{\alpha} \) to \( \frac{AF}{\alpha} \); and consequently the repulsion of that small part of \( B \), on \( D \), is to the repulsion of the corresponding part of \( b \) on \( d \), as \( \frac{AF}{\alpha^2} \), or \( \frac{1}{\alpha} \) to \( \frac{1}{\alpha} \). But the quantity of fluid in the small part \( DE \) of the canal, is to that in \( de \), as \( DE \) to \( de \), or as \( \alpha \) to \( \alpha \); therefore the repulsion of \( B \) on the fluid in \( DE \), is equal to that of \( b \) on the fluid in \( de \); therefore taking \( a \) to \( \alpha \), as \( \alpha \) to \( \alpha \), the repulsion of \( B \) on the fluid in \( ag \), is equal to that of \( B \) on the fluid in \( \alpha \); but the repulsion of \( b \) on \( ag \) may be considered as the same as its repulsion on \( \alpha \); for, by the supposition, the repulsion of \( B \) on \( \alpha \) may be considered as the same as if it was continued infinitely; and therefore the repulsion of \( B \) on \( ag \) may be considered as the same as if it was continued infinitely.

Corol. By just the same method of reasoning it appears, that if the bodies are undercharged, the quantity of deficient fluid in \( B \) will be to that in \( B \), as \( \alpha \) to \( \alpha \).

**Prop. XIX.** Let a thin flat plate be connected to any other body, as in the preceding proposition, by a canal of incompressible fluid, perpendicular to the plane of the plate; and let that body be overcharged; then the quantity of redundant fluid in the plate will bear very nearly the same proportion to that in the other body, whatever the thickness of the plate may be, provided its thickness is very small in proportion to its breadth, or smallest diameter. For there can be no doubt, but under that restriction, the fluid will be disposed very nearly in the same manner in the plate, whatever its thickness may be; and therefore its repulsion on the fluid in the canal will be very nearly the same, whatever its thickness may be.

**Prop. XX.** Let \( AB \) and \( DF \), Fig. 14, represent two equal and parallel circular plates, whose centres are \( C \) and \( E \); let the plates be placed so, that a right line joining their centres shall be perpendicular to the
plates; let the thickness of the plates be very small in respect of their distance CE; let the plate AB communicate with the body H, and the plate DF with the body L, by the canals CG and EM of incompressible fluid, such as are described in Prop. 17; let these canals meet their respective plates in their centres C and E, and be perpendicular to the plane of the plates; and let their length be so great, that the repulsion of the plates on the fluid in them may be considered as the same as if they were continued infinitely; let the body H be overcharged, and let L be saturated. It is plain, from Prop. 10, that DF will be undercharged, and AB will be more overcharged than it would otherwise be. Suppose now, that the redundant fluid in AB is disposed in the same manner as the deficient fluid in DF; let P be to 1, as the force with which the plate AB would repel the fluid in CE, if the canal ME was continued to C, is to the force with which it would repel the fluid in CM; and let the force with which AB repels the fluid in CG be to the force with which it would repel it, if the redundant fluid in it was spread uniformly, as π to 1; and let the force with which the body H repels the fluid in CG, be the same with which a quantity of redundant fluid, which we will call B, spread uniformly over AB, would repel it in the contrary direction. Then will the redundant fluid in AB be equal to \(\frac{B}{2}\pi r^2 - \frac{B}{\pi}r^2\); and therefore, if P is very small, will be very nearly equal to \(\frac{B}{2}\pi r^2\)

and the deficient fluid in DF will be to the redundant fluid in AB, as 1 - P to 1; and therefore, if P is very small, will be very nearly equal to the redundant fluid in AB.

For it is plain, that the force with which AB repels the fluid in EM, must be equal to that with which DF attracts it; for otherwise some fluid would run out of DF into L, or out of L into DF: for the same reason, the excess of the repulsion of AB on the fluid in CG, above the attraction of FD on it, must be equal to the force with which a quantity of redundant fluid equal to B, spread uniformly over AB, would repel it, or it must be equal to that with which a quantity equal to \(\frac{B}{\pi}\) spread in the manner in which the redundant fluid is actually spread in AB, would repel it. By the supposition, the force with which AB repels the fluid in EM, is to the force with which it would repel the fluid in CM, supposing EM to be continued to C, as 1 - P to 1; but the force with which any quantity of fluid in AB would repel the fluid in CM, is the same with which an equal quantity similarly disposed in DF, would repel the fluid in EM; therefore the force with which the redundant fluid in AB repels the fluid in EM, is to that with which an equal quantity similarly disposed in DF, would repel it, as 1 - P to 1; therefore, if the redundant fluid in AB be called A, the deficient fluid in DF must be \(A \times (1 - P)\); for the same reason, the force with which DF attracts the fluid in CG, is to that with which AB repels it, as \(A \times (1 - P)\) to \(A \times (1 - P)\); and therefore, the excess of the force with which AB repels CG, above that with which DF attracts it, is equal to that with which a quantity of redundant fluid equal to \(A \times (1 - P)\), or \(A \times (2P - P)\), spread over AB, in the manner in which the redundant fluid in it is actually spread, would repel it; therefore, \(A \times (2P - P)\) must be equal to \(\frac{B}{\pi}\) or \(A\) must be equal to \(\frac{B}{2\pi} - \frac{B}{\pi}\).

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**Corol. 1.** If the density of the redundant fluid near the middle of the plate AB is less than the mean density, or the density which it would every where be, if it was spread uniformly, in the ratio of 3 to 1; and if the distance of the two plates is so small, that \(EC = \frac{1}{2m}\) is very small in respect of \(AC = \frac{1}{n}\), and that \(EC = \frac{1}{2m}\) is very small in respect of \(AC = \frac{1}{n}\), the quantity of redundant fluid in AB will be greater than

\[
\frac{B}{2\pi} \left( \frac{AC}{EC} \right)^{1-n}, \text{ and less than } \frac{B}{2\pi} \left( \frac{AC}{EC} \right)^{1-n}.
\]

but will approach much nearer to the latter value than the former. For, in this case, \(P\) is, by lemma 10, coroll. 4; less than \(\frac{EC}{AC}\) and greater than \(\frac{EC}{AC} \times \frac{1}{2}\), but approaches much nearer to the latter value than the former; and if \(EC = \frac{1}{n}\) is very small in respect of \(AC = \frac{1}{n}\), \(P\) is very small.

**Remarks.** If DF was not undercharged, it is certain that AB would be considerably more overcharged near the circumference of the circle than near the centre; for if the fluid was spread uniformly, a particle placed any where at a distance from the centre, as at N, would be repelled with considerably more force towards the circumference, than it would towards the centre. If the plates are very near together, and consequently DF nearly as much undercharged as AB is overcharged, AB will still be more overcharged near the circumference than near the centre, but the difference will not be near so great as in the former case: for, let NR be many times greater than CE, and NS less than CE; and take ER and ES equal to CR and CS; there can be no doubt, he thinks, that the deficient fluid in DF will be lodged nearly in the same manner as the redundant fluid in AB; and therefore the repulsion of the redundant fluid at R, on a particle at N, will be very nearly balanced by the attraction of the redundant matter at r, for R is not much nearer to N than r is; but the repulsion of R will not be near balanced by that of r; for the distance of S from N is much less than that of s. Let now a small circle, whose diameter is ST, be drawn round the centre N, on the plane of the plate; as the density of the fluid is greater at T than at S, the repulsion of the redundant fluid within the small circle tends to impel the point N towards C; but as there is a much greater quantity of fluid between N and B than between N and A, the repulsion of the fluid without the small circle tends to balance that; but the effect of the fluid within the small circle is not much less than it would be, if DF was not undercharged; whereas much the greater part of the effect of that part of the plate on the outside of the circle, is taken off by the effect of the corresponding part of DF; consequently the difference of density between T and S will not be near so great, as if DF was not undercharged. Hence it is probable, that if the two plates are very nearly together, the density of the redundant fluid near the centre will not be much less than the mean density, or \(P\) will not be much less than \(\frac{1}{2}\); moreover, the less the distance of the plates, the nearer will \(P\) approach to 1.

**Corol. 2.** Let now the body H consist of a circular plate, of the same size as AB, placed so that the canal CG shall pass through its centre, and be perpendicular to its plate; by the supposition the force with which H repels the fluid in the canal CG, is the same with which a quantity of fluid, equal to B, spread uniformly over AB, would repel it in a contrary direction; therefore, if the fluid in the plate H was spread uniformly,

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the quantity of redundant fluid in it would be $B$; and
if it was all collected in the circumference, would be
$2B \times \frac{3}{\pi}$; and therefore the real quantity will be greater
than $B$, and less than $2B \times \frac{3}{\pi}$.

Corol. 3. Therefore, if we suppose $\vartheta$ to be equal to 1, the
quantity of redundant fluid in $AB$ will exceed that in
the plate $H$, in a greater ratio than that of
$\left(\frac{AC}{CE}\right)^{\frac{3}{4}} \times \frac{3}{\pi}$ to 1, and less than that of $2B \times \frac{3}{\pi}$: and from the preceding remarks it appears, that the real
quantity of redundant fluid in $AB$ can hardly be much
greater than it would be if $\vartheta$ was equal to 1.

Corol. 4. Hence the redundant fluid in $AB$, suppos-
ing $\vartheta$ to be equal to 1, will exceed that in the plate $H$,
in a greater ratio than that of $AC$ to $4CE$, and less than that of $AC$ to $2CE$.

Corol. 5. Let now the body $H$ consist of a globe
whose diameter equals $AB$; the globe being situated in
such a manner that the canal $CG$, if continued, would
pass through its centre; the quantity of redundant fluid in
the globe will be $2B$; for the fluid will be spread
uniformly over the surface of the globe, and its repul-
sion on the canal will be the same as if it was all collected
in the centre of the sphere, and will therefore be the
same with which an equal quantity, disposed in the
circumference of $AB$, would repel it in the contrary
direction, or with which half that quantity, or $B$, would
repel it, if spread uniformly over the plate.

Corol. 6. Therefore, if $\vartheta$ was equal to 1, the
redundant fluid in $AB$ would exceed that in the globe, in the
ratio of $AC$ to $4CE$; and therefore it will in reality ex-
ceed that in the globe, in a rather greater ratio than that
of $AC$ to $4CE$; but if the plates are very near together,
it will approach very near to that ratio, and the nearer
the plates are, the nearer it will approach to it.

Corol. 7. If the body $H$ is as much undercharged as
it was before overcharged, $AB$ will be as much under-
charged as it was before overcharged, and $DF$ as
much overcharged as it was before undercharged.

Corol. 8. If the size and distance of the plates be al-
terred, the quantity of redundant or deficient fluid in the
body $H$ remaining the same, it appears, by comparing
this proposition with the 18th and 19th propositions,
that the quantity of redundant and deficient fluid in
$AB$, will be as $AC^{-\vartheta} \times \left(\frac{AC}{EC}\right)^{\frac{3}{4}}$, or as $AC^{-\vartheta} \times \frac{AC^3}{EC^3}$: suppos-
ing the value of $\vartheta$ to remain the same.

Prop. XXI. If $AB$ and $DF$, Fig. 17, represent
the two plates, and $H$ and $L$ the bodies communi-
cating with them; let now $H$ be removed to $h$, and let
it communicate with $AB$, by the bent canal $gc$, the
quantity of fluid in the plates and bodies remaining
the same as before, and let us, for the sake of ease in the
demonstration, suppose the canal $gc$ to be every where
of the same thickness as the canal $CG$, though the pro-
position will evidently hold equally good whether it is
or not, then the fluid will still be in equilibrio. For let
us first suppose the canal $gc$ to be continued through
the substance of the plate $AB$ to $C$, along the line $crC$; the
part $crC$ being of the same thickness as the rest of the
canal, and the fluid in it of the same density: by the pre-
ceding proposition, the repulsion or attraction of each
particle of fluid or matter in the plates $AB$ and $DF$, on
the fluid in the whole canal $Creg$, in the direction of that
canal, is equal to its repulsion or attraction on the fluid in
the canal $CG$, in the direction $CG$; and therefore the
whole repulsion or attraction of the two plates on the
canal $Creg$ is equal to their repulsion or attraction on $CG$;
but as the fluid in the plate $AB$ is in equilibrio, each
particle of fluid in the part $Creg$ of the canal, is impelled
by the plates, with as much force in one direction as the
other, and consequently the plates impel the fluid in the
canal $cg$, with as much force as they do that in the
whole canal $Creg$, that is, with the same force that they
impel the fluid in $CG$. In like manner the body
$h$ impels the fluid in $cg$, with the same force that $H$ does
the fluid in $CG$, and consequently $h$ impels the fluid in
$cg$ one way in the direction of the canal, with the same
force that the two plates impel it the contrary way, and
therefore the fluid in $cg$ has no tendency to flow from
one body to the other.

Corol. By the same method of reasoning, with the
help of the corollary to the 21st proposition, it appears
that if $AB$ and $H$ each communicate with a third body,
y canals of incompressible fluid, and a communication
is made between $AB$ and $H$ by another canal of incom-
pressible fluid, the fluid will have no tendency to flow
from one to the other through this canal, supposing that
the fluid was in equilibrio before this communication was
made. In like manner, if $AB$ and $H$ communicate with
each other, or each communicate with a third body, by
canals of real fluid, instead of the imaginary canals of
incompressible fluid used in these propositions, and a communication is also made between them by a canal of incompressible fluid, the fluid can have no tendency to flow from one to the other. The truth of the latter part of this corollary will appear by supposing an imaginary canal of incompressible fluid to be continued through the whole length of the real one.

Prop. XXII. Let now a communication be made between the two plates AB and DF, by the canal NRS of incompressible fluid of any length, and let the body H and the plate AB be overcharged. It is plain that the fluid will flow through that canal from AB to DF. Now the whole force with which the fluid in the canal is impelled along it, by the joint action of the two plates, is the same with which the whole mass of fluid in the canal CG or CG is impelled by them, supposing the canal NRS to be every where of the same breadth and thickness as CG or CG. For suppose that the canal NRS, instead of communicating with the plate DF, is bent back just before it touches it, and continued infinitely along the line Ss; the force with which the fluid in the canal is impelled along it, by the joint action of the two plates, is the same with which they impel that in EL, supposing SS to be of the same breadth and thickness as ES, and is therefore nothing; therefore the force with which they impel the fluid in NRS, is the same with which they impel that in CG.

Prop. XXIV. Let now xys be a body of an infinite size, containing just fluid enough to saturate it; and let a communication be made between x and xys, by the canal hy of incompressible fluid, of the same breadth and thickness as gc or GC, the fluid will flow through it from x to xys; and the force with which the fluid in that canal is impelled along it, is equal to that with which the fluid in NRS is impelled by the two plates.

If the canal hy is of so great a length, that the repulsion of h on it is the same as if it was continued infinitely, then the thing is evident; but if it is not, let the canal hy, instead of communicating with xys, so that the fluid may flow out of the canal into xys, be continued infinitely through its substance, along the line yv: now, it must be observed, that a small part of the body xys, namely that which is turned towards x, will, by the action of h on it, be rendered undercharged, but all the rest of the body will be saturated; for the fluid driven out of the undercharged part will not make the remainder, which is supposed to be of an infinite size, sensibly overcharged: now the force with which the fluid in the infinite canal hyv, is impelled by the body h and the undercharged part of xys, is the same with which the fluid in gc is impelled by them; but as the fluid in yv cannot be impelled in any direction; and therefore the fluid in hy is impelled with as much force as that in hy, and therefore the fluid in hy is impelled with as much force as that in gc, and is therefore impelled with as much force as the fluid in NRS is impelled by the two plates.

It perhaps may be asked, whether this method of demonstration would not equally tend to prove that the fluid in hy was impelled with the same force as that in NRS, though xys did not contain just fluid enough to saturate it; but this is not the case, for this demonstration depends on the canal yv being continued, within the body xys, to an infinite distance beyond any over or under charged part, which could not be if xys contained either more or less fluid than that is.

Prop. XXV. Let two bodies B and b, Fig. 13, be joined by a cylindrical or prismatic canal Aa, filled with real fluid, and not by an imaginary canal of incompressible fluid, as in the 16th proposition, and let the fluid in it be in equilibrio, the force with which the whole or any given part of the fluid in the canal, is impelled in the direction of its axis, by the united repulsions and attractions of the redundant fluid or matter in the two bodies and the canal, must be nothing; or the force with which it is impelled one way in the direction of the axis of the canal, must be equal to that with which it is impelled the other way. For as the canal is supposed cylindrical or prismatic, no particle of fluid in it can be prevented from moving in the direction of its axis, by the sides of the canal; and therefore the force with which each particle is impelled either way in the direction of the axis, by the united attractions and repulsions of the two bodies and the canal, must be nothing, otherwise it could not be at rest; and therefore the force with which the whole, or any given part of the fluid in the canal, is impelled in the direction of the axis, must be nothing.

Corol. 1. If the fluid in the canal is disposed in such a manner, that the repulsion or attraction of the redundant fluid or matter in it, on the whole or any given part of the fluid in the canal, has no tendency to impel it either way in the direction of the axis; then the force with which that whole or given part is impelled by the two bodies, must be nothing; or the force with which it is impelled one way in the direction of the axis, by the body B, must be equal to that with which it is impelled in the contrary direction by the other body, but not if the fluid in the canal is disposed in a different manner.

Corol. 2. If the bodies, and consequently the canal, is overcharged; then, in whatever manner the fluid in the canal is disposed, the force with which the whole quantity of redundant fluid in the canal is repelled by the body B, in the direction B, must be equal to that with which it is repelled by b, in the contrary direction. For the force with which the redundant fluid is impelled in the direction B, by its own repulsion, is nothing; for the repulsion of the particles of any body on each other, have no tendency to make the whole body move in any direction.

Sect. II. Comparison of the preceding Hypothesis with Experiments.

1. It appears from experiment, that some bodies suffer the electric fluid to pass with great readiness between their pores, while others will not suffer it to do so without great difficulty, and some hardly suffer it to do so at all. The first sort of bodies are called conductors, the others non-conductors. It is evident that the electric fluid in non-conductors may be considered as moveable, or answering to the definition given of that term immediately before Prop. 1. As to the fluid contained in non-conducting substances, though it does not absolutely answer to the definition of immovable, as it is not absolutely confined from moving, but only does so with great difficulty; yet it may in most cases be considered as such without sensible error. Air does in some measure permit the electric fluid to pass through it; though, if it is dry, it lets it pass but very slowly, and not without difficulty, it is therefore to be called a non-conductor.

It appears that conductors would readily suffer the fluid to run in and out of them, were it not for the air which surrounds them; for if the end of a conductor is inserted into a vacuum, the fluid runs in and out of it with perfect readiness; but when it is surrounded on all sides with conducting matter, it is seen to be sensibly impeded. The reason of this is, that the fluid, in consequence of the action of the conducting matter, does not pass along the surface of the conductor, but is carried between the conducting matter and the conductor, which makes its way with some difficulty. This is the true reason why the electric fluid is carried between conducting matter, and not by the conducting matter directly, as in water, when it is carried between the spaces between the conducting matter. But the conducting matter is not fourteen times as heavy as water. For if we pour water into a vessel, and, while the water is pouring, we put in a conductor, it does not impede the water's passing in; but, if we put a conducting matter in the water while it is pouring, it will impede the water's passing in.
ELECTRICITY.

Theoretical Electricity.

Explanation of positive and negative electricity.

Electrified if understood, but overcharged is an
for small repulsion, as but and its body
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If and very

Electrified, or other causes; yet the bulk of the
earth, and especially the interior parts, must be
saturated with electricity. Therefore assume any part of
the earth which is itself saturated, and is at a great
distance from any over or under charged part; any
body communicating with the ground, contains as much
electricity as it communicated with this part by a

canal of an incompressible fluid, and therefore is not at
all electrified.

If any body A, insulated, and saturated with
electricity, is placed at a great distance from any over
or under charged body, it is plain that it cannot be
electrified; but if an overcharged body is brought near it, it
will be positively electrified; for supposing A to com-
communicate with any body B, at an infinite distance, by
a canal of an incompressible fluid, it is plain that unless B
is overcharged, the fluid in the canal could not be in
equilibrium, but would run from A to B. For the same
reason, a body insulated and saturated with fluid,
will be negatively electrified if placed near an un-
dercharged body.

2. The phenomena of the attraction and repulsion
of electrified bodies seem to agree exactly with the the-
ory; as will appear by considering the following cases.

Case 1. Let two bodies, A and B, both conductors of
electricity, and both placed at a great distance from any
other electrified bodies, be brought near each other. Let A
be insulated, and contain just fluid enough to saturate
it; and let B be positively electrified. They will at-
tract each other; for as B is positively electrified, and
at a great distance from any other overcharged body, it
will be overcharged; therefore, on approaching A and B
to each other, some fluid will be driven from that part
of A which is nearest to B to the farther part: but
when the fluid in A was spread uniformly, the repul-
sion of B on the fluid in A was equal to its attraction on
the matter in it; therefore when some fluid is removed
from those parts where the repulsion of B is strongest,
to those where it is weaker, B will repel the fluid in A
with less force than it attracts the matter; and conse-
quently the bodies will attract each other.

Case 2. If we now suppose that the fluid is at li-
berty to escape out of A, if it has any disposition to
do so, the quantity of fluid in it before the approach of
B being still sufficient to saturate it; that is, if A is not
insulated and not electrified, B being still positively
electrified, they will attract with more force than be-
fore: for in this case, not only some fluid will be driven
from that part of A which is nearest to B to the
opposite part, but also some fluid will be driven out of
A. It must be observed, that if the repulsion of B on
a particle at E, Fig. 19, the farthest part of A, is very
small in respect of its repulsion on an equal particle
placed at D, the nearest part of A, the two bodies will
attract with very nearly the same force, whether A is
insulated or not; but if the repulsion of B, on a particle
at E, is very near as great as on one at D, they will
attract with very little force if A is insulated. For in-
stance, let a small overcharged ball be brought near
one end of a long conductor not electrified; they will
attract with very near the same force, whether the
conductor be insulated or not; but if the conductor
be overcharged, and brought near a small electrified
ball, they will not attract with near so much force, if
the ball is insulated, as if it is not.

Case 3. If we now suppose that A is negatively elec-
trified, and not insulated, it is plain that they will at-
tract with more force than in the last case; as A will be
still more undercharged in this case than in the last.

N. B. In these three cases, we have not as yet taken

PLATE CULL.

Fig. 19.
notice of the effect which the body A will have in altering the quantity and disposition of the fluid in B; but in reality this will make the bodies attract each other with more force than they would otherwise do; for in each of these cases the body A attracts the fluid in B; which will cause some fluid to flow from the farther parts of B to the nearer, and will also cause some fluid to flow into it, if it is not insulated, and will consequently cause B to act upon A with more force than it would otherwise do.

Case 4. Let us now suppose that B is negatively electrified; and let A be insulated, and contain just fluid enough to saturate it, they will attract each other; for B will be undercharged; it will therefore attract the fluid in A, and will cause some fluid to flow from the farthest part of A, where it is attracted with less force, to the nearest part, where it is attracted with more force; so that B will attract the fluid in A with more force than it repels the matter.

Case 5 and 6. If A is now supposed to be not insulated and not electrified, B being still negatively electrified; it is plain that they will attract with more force than in the last case: and if A is positively electrified, they will attract with still more force.

In these last three cases also, the effect which A has in altering the quantity and disposition of the fluid in B, tends to increase the force with which the two bodies attract.

Case 7. It is plain, that a non-conducting body saturated with fluid, is not at all attracted or repelled by an over or under charged body, until, by the action of the electrified body on it, it has either acquired some additional fluid from the air, or had some driven out of it, or till some fluid is driven from one part of the body to the other.

Case 8. Let us now suppose that the two bodies A and B are both positively electrified in the same degree. It is plain, that were it not for the action of one body on the other, they would both be overcharged, and would repel each other. But it may perhaps be said, that one of them, as A, may, by the action of the other on it, be either rendered undercharged on the whole, or at least may be rendered undercharged in that part nearest to B; and that the attraction of this undercharged part on a particle of the fluid in B, may be greater than the repulsion of the more distant overcharged part; so that on the whole the body A may attract a particle of fluid in B. If so, it must be affirmed, that the body B repels the fluid in A; for otherwise, that part of A which is nearest to B could not be rendered undercharged. Therefore, to obviate this objection, let the bodies be joined by the straight canal DC of incompressible fluid (Fig. 19.) The body B will repel the fluid in all parts of this canal; for as A is supposed to attract the fluid in B, B will not only be more overcharged than it would otherwise be, but it will also be more overcharged in that part nearest to A, than in the opposite part. Moreover, as the near undercharged part of A is supposed to attract a particle of fluid in B, with more force than the more distant overcharged part repels it; it must, a fortiori, attract a particle in the canal with more force than the other repels it; therefore the body A must attract the fluid in the canal; and consequently some fluid must flow from B to A, which is impossible; for as A and B are both electrified in the same degree, they cannot contain the same quantity of fluid as they both communicated with a third body at an infinite distance, by canals of incompressible fluid, and therefore by the cor. to Prop. 22, if a communication is made between them by a canal of incompressible fluid, the fluid would have no disposition to flow from one to the other.

Case 9. But if one of the bodies, as A, is positively electrified in a less degree than B, then it is possible for the bodies to attract each other; for in this case the force with which B repels the fluid in A may be so great, as to make the body A either entirely undercharged, or at least to make the nearest part of it so much undercharged, that A shall on the whole attract a particle of fluid in B. It may be worth remarking, with regard to this case, that when two bodies, both electrified positively but unequally, attract each other, you may, by removing them to a greater distance from each other, cause them to repel; for as the stronger electrified body repels the fluid in the weaker with less force when removed to a greater distance, it will not be able to drive so much fluid out of it, or from the nearer to the farther part, as when placed at a less distance.

Case 10 and 11. By the same reasoning it appears, that if the two bodies are both negatively electrified in the same degree, they must repel each other: but if they are both negatively electrified in different degrees, it is possible for them to attract each other.

All these cases are conformable to experiment.

Case 12. Let two cork balls be suspended by conducting threads, from the same positively electrified body, in such a manner, that if they did not repel, they would hang close together; they will both be equally electrified, and will repel each other: let now an overcharged body, more strongly electrified than them, be brought under them; they will become less overcharged, and will separate less than before: on bringing the body still nearer, they will become not at all overcharged, and will not separate at all: and on bringing the body still nearer, they will become undercharged, and will separate again.

Case 13. Let all the air of a room be overcharged; and let two cork balls be suspended close to each other by conducting threads communicating with the wall. By Prop. 13, it is highly probable that the balls will be undercharged, and therefore they should repel each other.

These last two cases are experiments of Mr. Canton's, and are described in Phil. trans. 1758, p. 350, where are other experiments of the same kind, all readily explicable by the preceding theory.

3. On the cases in which bodies receive electricity from or part with it to the air.

Lemma 1. Let the body A, Fig. 6, either stand near some over or under charged body, or at a distance from it. It seems highly probable, that if any part of its surface, as MN, is overcharged, the fluid will endeavour to run out through that part, provided the air adjacent to it is not overcharged.

For let G be any point in that surface, and P a point within the body, extremely near to it; it is plain that a particle of fluid at P must be repelled with as much force in one direction as another (otherwise it could not be at rest), unless all the fluid between P and G is pressed close together; in which case it may be repelled with more force towards G, than it is in the contrary direction: now, a particle at G is repelled in the direction PG, i.e. from P to G, by all the redundant fluid between P and G; and a particle at P is repelled by the same fluid in the contrary direction; so that, as the particle at P is repelled with not less force in the direction PG than in the contrary, Mr. C. does not see how a particle at G can help being repelled with more force in that direction than the contrary, unless the air on the outside of the surface MN was more overcharged than the space between P and G.

Lemma 2. On cases in which bodies receive electricity from or part with it to the air.
In like manner, if any part of the surface is undercharged, the fluid will have a tendency to run in at that part from the air. The truth of this is somewhat confirmed by the 2d problem; as in all the cases of that problem, the fluid was shown to have a tendency to run out of the spaces AD and EH, at any surface which was overcharged, and to run in at any which was undercharged.

Corol. 1. If any body at a distance from other over or under charged bodies, be positively electrified, the fluid will gradually run out of it from all parts of its surface into the adjoining air; as it is plain that all parts of the surface of that body will be overcharged, and if the body is negatively electrified, the fluid will gradually run into it at all parts of its surface from the adjoining air.

Corol. 2. Let the body A, Fig. 6, insulated, and containing just fluid enough to saturate it, be brought near the overcharged body B; that part of the surface of A which is turned towards B will, by Prop. 2, be rendered undercharged, and will therefore imbibe electricity from the air; and at the opposite surface RS, the fluid will run out of the body into the air.

Corol. 3. If we now suppose that A is not insulated, but communicates with the ground, and consequently that it contained just fluid enough to saturate it before the approach of B, it is plain that the surface MN will be rendered undercharged before; and therefore the fluid will run in there with more force than before; but it can hardly have any disposition to run out at the opposite surface RS; for if the canal by which A communicates with the ground is placed opposite to B, as in Fig. 5, then the fluid will run out through that canal, till it has no longer any tendency to run out at RS; and by the remarks at the end of Prop. 25, it seems probable that the fluid in A will be nearly in the same quantity, and disposed nearly in the same manner, into whatever part of A the canal is inserted, by which it communicates with the ground.

Corol. 4. If B is undercharged, the case will be reversed; that is, it will run out where it before ran in, and will run in where it before ran out.

These corollaries seem conformable to experiment: thus far is certain, that bodies at a distance from other electrified bodies receive electricity from the air, if negatively electrified, and part with some to it if positively electrified: and a body not electrified, and not insulated, receives electricity from the air if brought near an overcharged body, and loses some when brought near an undercharged body: and a body insulated and containing its natural quantity of fluid, in some cases receives, and in others loses electricity, when brought near an over or under charged body.

4. The well-known effects of points in causing a quick discharge of electricity, seem to agree very well with this theory.

It appears from the 18th Proposition, that if two similar bodies of different sizes are placed at a very great distance from each other, and connected by a slender canal, and overcharged, the force with which a particle of fluid, placed close to corresponding parts of their surface, is repelled from them, is inversely as the corresponding diameters of the bodies. If the distance of the two bodies is small, there is not so much difference in the force with which the particle is repelled by the two bodies; but still, if the diameters of the two bodies are very different, the particle will be repelled with much more force from the smaller body than from the larger. It is true, indeed, that a particle placed at a certain distance from the smaller body, will be repelled with less force than if it be placed at the same distance from the greater body; but this distance is, in most cases, very considerable; if the bodies are spherical, and the repulsion inversely as the square of the distance, a particle placed at any distance from the surface of the smaller body, less than a mean proportional between the radii of the two bodies, will be repelled from it with more force than if it be placed at the same distance from the larger body.

Hence, if two similar bodies are connected together by a slender channel, and are overcharged, the fluid must escape faster from a smaller body than from an equal surface of the larger; but as the surface of the larger body is greatest, it does not appear which body ought to lose most electricity in the same time; and indeed it seems impossible to determine positively from this theory which should, as it depends in great measure on the manner in which the air opposes the entrance of the electric fluid into it. Perhaps in some degrees of electrification the smaller body may lose most, and in others the larger.

Let now ACB, Fig. 18, be a conical point, standing on any body DAB, C being the vertex of the cone; and let DAB be overcharged: A particle of fluid placed close to the surface of the cone, any where between A and C, must be repelled with at least as much, if not more force, than it would, if the part A B of the cone was taken away, and the part a CB connected to DAB by a slender canal; and consequently, from what has been said before, it seems reasonable to suppose, that the waste of electricity from the end of the cone must be very great in proportion to its surface; though it does not appear from this reasoning, whether the waste of electricity from the whole cone, should be greater or less than from a cylinder of the same base and altitude. All that has been here said relating to the flowing out of electricity from overcharged bodies, holds equally true with regard to the flowing in of electricity into undercharged bodies.

But a circumstance which contributes as much as any thing to the quick discharge of electricity from points, is the swift current of air caused by them, and taken notice of by Mr Wilson and Dr Priestley, (see Priestley, p. 117 and 591); and which is produced in this manner. If a globular body ABD is overcharged, the air close to it, all round its surface, is rendered overcharged by the electric fluid, which flows into it from the body; it will therefore be repelled by the body; but as the air all round the body is repelled with the same force, it is in equilibrio, and has no tendency to fly off from it. If now the conical point ACB be made to stand out from the globe, as the fluid will escape much faster in proportion to the surface from the end of the point, than from the rest of the body, the air close to it will be much more overcharged than that close to the rest of the body; it will therefore be repelled with much more force; and consequently a current of air will flow along the sides of the cone from B towards C; by which means there is a continual supply of fresh air, not much overcharged, brought in contact with the point; whereas otherwise the air adjoining to it would be so much overcharged, that the electricity would have but little disposition to flow from the point into it.

The same current of air is produced in a less degree, without the help of the point, if the body, instead of being globular, is oblong or flat, or has knobs on it, or is otherwise formed in such a manner as to make the electricity escape faster from some parts of it than the rest.
In like manner, if the body ABD be undercharged, the air adjoining to it will also be undercharged, and will therefore be repelled by it; but as the air close to the end of the point will be more undercharged than that close to the rest of the body, it will be repelled with much more force; which will cause exactly the same current of air, flowing the same way, as if the body was overcharged; and consequently the velocity with which the electric fluid flows into the body, will be very much increased. Mr C. believes, indeed, that it may be laid down as a constant rule, that the faster the electric fluid escapes from any body when overcharged, the faster will it run into that body when undercharged.

Points are not the only bodies which cause a quick discharge of electricity; in particular, it escapes very fast from the ends of long slender cylinders; and a swift current of air is caused to flow from the middle of the cylinder towards the end: this will easily appear by considering, that the redundant fluid is collected in much greater quantity near the ends of the cylinders, than near the middle. The same thing may be said, but he believes in a less degree, of the edges of thin plates.

What has been just said concerning the current of air, serves to explain the reason of the revolving motion of Dr Hamilton's and Mr Kinnersley's bent pointed wires, (see Phil. Trans. vol. li. p. 905, and vol. liii. p. 86; also Priestley, p. 429, and 440 of this article): for the same reason which impels the air from the thick part of the wire towards the point, tends to impel the wire in the contrary direction.

It is well known, that if a body B is positively electrified, and another body A, communicating with the ground, be then brought near it, the electric fluid will escape faster from B, at that part of it which is turned towards A, than before. This is plainly conformable to theory; for as A is thus rendered undercharged, B will in its turn be made more overcharged, in that part of it which is turned towards A, than it was before. But it is also well known, that the fluid will escape faster from B, if A be pointed, than if it be blunt; though B will be less overcharged in this case than in the other; for the broader the surface of A, which is turned towards B, the more effect will it have in increasing the overcharge of B. The cause of this phenomenon is as follows:

If A is pointed, and the pointed end turned towards B, the air close to the point will be very much undercharged, and therefore will be strongly repelled by A, and attracted by B, which will cause a swift current of air to flow from it towards B, by which means a constant supply of undercharged air will be brought in contact with B, which will accelerate the discharge of electricity from it in a very great degree; and, moreover, the more pointed A is, the swifter will be this current. If, on the other hand, that end of A which is turned towards B is so blunt, that the electricity is not disposed to run into A faster than it is to run out of B, the air adjoining to B may be as much overcharged as that adjoining to A is undercharged; and therefore may, by the joint repulsion of B and attraction of A, be impelled from B to A, with as much or more force than the air adjoining to A is impelled in the contrary direction; so that what little current of air there is, may flow in the contrary direction.

It is easy to apply what has been here said to the case in which B is negatively electrified.

5. In the paper of Mr Canton's, quoted in the 5th section, and in a paper of Dr Franklin's (Phil. Trans. 1775, p. 800, and Franklin's Letters, p. 155) are some remarkable experiments, showing that when an overcharged body is brought near another body, some fluid is driven to the farther end of this body, and also some driven out of it, if it is not insulated. The experiments are all strictly conformable to the 9th, 10th, and 11th propositions; but it is needless to point out the agreement, as to the explanation given by the authors does it sufficiently.

6. On the Leyden Phial.—The shock produced by the Leyden phial seems owing only to the great quantity of redundant fluid collected on its positive side, and the great deficiency on its negative side; so that if any conductor was prepared of so great a size, as to be able to receive as much additional fluid by the same degree of electrification, as the positive side of a Leyden phial, and was positively electrified in the same degree as the phial, he does not doubt but what as great a shock would be produced by making a communication between this conductor and the ground, as between the two surfaces of the Leyden phial, supposing both communications to be made by canals of the same length and same kind.

It appears plainly from the experiments which have been made on this subject, that the electric fluid is not able to pass through the glass; but yet it seems as if it was able to penetrate, without much difficulty, to a certain small depth, perhaps he might say an imperceptible depth, within the glass; as Dr Franklin's analysis of the Leyden phial shows that its electricity is contained chiefly in the glass itself, and that the coating is not greatly over or under charged.

It is well known that glass is not the only substance which can be charged in the manner of the Leyden phial; but that the same effect may be produced by any other electric.

Hence* the phenomena of the phial seem easily explicable by means of the 20th proposition. For let CCLI. ACGM, Fig. 19, represent a flat plate of glass, or any other substance which will not suffer the electric fluid to pass through it, seen edgewise; and let BbDd, and EeFf, or Bd and Ef, as they may be called for shortness, be two plates of conducting matter of the same size, placed in contact with the glass opposite to each other; and let Bd be positively electrified; and let Ef communicate with the ground; and let the fluid be supposed either able to enter a little way into the glass, but not to pass through it, or unable to enter it at all; and if it is able to enter a little way into it, let b3d, or B3, as it may be called, represent that part of the glass into which the fluid can enter from the plate Bd, and cp that which the fluid from Ef can enter. By the above mentioned proposition, if bc, the thickness of the glass, is very small in respect of b, the diameter of the plates, the quantity of redundant fluid forced into the space Bd, or B3, that is, into the plate Bd, if the fluid is unable to penetrate at all into the glass, or into the plate Bd, and the space Bb3 together, if the fluid is able to penetrate into the glass, will be many times greater than what would be forced into it by the same degree of electrification, if it had been placed by itself; and the quantity of fluid driven out of Ef, will be nearly equal to the redundant fluid in Bb3.

*The following explanation is strictly applicable only to that sort of Leyden phial, which consists of a flat plate of glass or other matter. It is evident, however, that the result must be nearly of the same kind, though the glass is made into the shape of a bottle, as usual, or into any other form.
If a communication be now made between $B\beta$ and $E\phi$, by the canal $NRS$, the redundant fluid will pass from $B\beta$ to $E\phi$; and if in its way it passes through the body of any animal, it will, by the rapidity of its motion, produce in it that sensation called a shock.

It appears from the 2nd proposition, that if a body of any size were electrified in the same degree as the plate $B\beta$, and a communication was made between that body and the ground, by a canal of the same length, breadth, and thickness, as $NRS$; then the fluid in that canal would be impelled with the same force as that in $NRS$, supposing the fluid in both canals to be incompressible; and consequently, as the quantity of fluid to be moved, and the resistance to its motion, are the same in both canals, the fluid should move with the same rapidity in both; and there is no reason to think that the case will be different, if the communication is made by canals of real fluid.

Therefore what was said in the beginning of this Section, namely, that as great a shock would be produced by making a communication between the conductor and the ground, as between the two sides of the Leyden phial, by canals of the same length and same kind, seems a necessary consequence of this theory; as the quantity of fluid which passes through the canal is, by the supposition, the same in both; and there is the greatest reason to think, that the fluid with which it passes will be nearly, if not quite, the same in both.

It may be worth observing, that the longer the canal $NRS$ is, by which the communication is made, the less will be the rapidity with which the fluid moves along it; for the longer the canal is, the greater is the resistance to the motion of the fluid in it; whereas the force with which the whole quantity of fluid in it is impelled, is the same, whatever be the length of the canal. Accordingly, it is found in melting small wires, by directing a shock through them, that the longer the wire the greater charge it requires to melt it.

As the fluid in $B\beta$ is attracted with great force by the redundant matter in $E\phi$, it is plain that if the fluid is able to penetrate at all into the glass, great part of the redundant fluid will be lodged in $B\beta$; and in like manner there will be a great deficiency of fluid in $E\phi$. But in order to form some estimate of the proportion of the redundant fluid, which will be lodged in $B\beta$, let the communication between $E\phi$ and the ground be taken away, as well as that by which $Bd$ is electrified; and let so much fluid be taken from $B\beta$, as to make the redundant fluid in it equal to the deficient fluid in $E\phi$. If we suppose that all the redundant fluid is collected in $B\beta$, and all the deficient in $E\phi$, so as to leave $Bd$ and $E\phi$ saturated; then, if the electric reflexion is inversely as the square of the distance, a particle of fluid placed anywhere in the plane $bd$, except near the extremities $b$ and $d$, will be attracted with very near as much force by the redundant matter in $E\phi$, as it is repelled by the redundant fluid in $B\beta$. Hence it follows, that if the depth to which the fluid can penetrate, is very small in respect of the thickness of the glass, but yet is such that the quantity of fluid naturally contained in $B\beta$, or $E\phi$, is considerably more than the redundant fluid in $B\beta$; then almost all the redundant fluid will be collected in $B\beta$, leaving the plate $Bd$ not very much undercharged; and in like manner $E\phi$ will not be very much undercharged.

7. In the experiment of Wilke and Epinus, called electrifying a plate of air, (see page 528,) it does not appear whether the air contained between the two boards is very much overcharged on one side, and very much undercharged on the other, as is the case with the plate of glass in the Leyden phial; or whether the case is, that the redundant or deficient fluid is lodged only in the two boards, and that the air between them serves only to prevent the electricity from running from one board to the other; but whichever of these is the case, the experiment is equally conformable to the theory.

It must be observed, that a particle of fluid, placed between the two plates, is drawn towards the undercharged plate, with a force exceeding that with which it would be repelled from the overcharged plate, if it was electrified with the same force, the other plate being taken away, nearly in the ratio of twice the quantity of redundant fluid contained in the plate, to that which it would contain if electrified with the same force by itself; so that, unless the plate is very weakly electrified, or their distance very considerable, the fluid will fly from one to the other, in the form of sparks.

8. Whenever any conducting body, as $A$, communicating with the ground, is brought sufficiently near an overcharged body $B$, the electric fluid is apt to fly through the air from $B$ to $A$, in the form of a spark: the way by which this is brought about seems to be this. The fluid placed anywhere between the two bodies, is repelled from $B$ towards $A$ and consequently move slowly through the air from one to the other; now it seems as if this motion increased the elasticity of the air, and made it rarer; this will enable the fluid to flow in a swifter current, which will still further increase the elasticity of the air, till at last it is so much rarefied, as to form very little opposition to the motion of the electric fluid, on which it flies in an uninterrupted mass from one body to the other.

In the same manner may the electric fluid pass from one body to another, in the form of a spark, if the first body communicates with the ground, and the other is negatively electrified, or in any other case in which one body is strongly disposed to part with its electricity to the air, and the other to receive it.

In like manner, when the electric fluid is made to pass through water, in the form of a spark, as in Becaria's* and Lane's† experiments, the water, by the rapid motion of the electric fluid through it, is turned into an elastic fluid, and so much rarefied as to make very little opposition to its motion; and when stones are burst or thrown out from buildings struck by lightning, that effect is probably caused by the moisture in the stone, or some of the stone itself being turned into an elastic fluid.

It appears plainly, from the sudden rising of the water in Kinneries's electric air thermometer,‡ that when the electric fluid passes through the air in the form of a spark, the air in its passage is either very much rarefied, or entirely displaced; and the bursting of the glass vessels, in Becaria's and Lane's experiments, shows that the same thing happens with regard to the water, when the electric fluid passes through it in the form of a spark. Now there are no means by which the displacing of the air or water can be brought about, but by supposing its elasticity to be increased, by the motion of the electric fluid through it, unless we suppose it to be actually pushed aside, by the force with which the electric fluid endeavours to issue from the overcharged body; but he can by no means think, that the force with which the fluid endeavours to issue, in the ordinary cases in which electric sparks are pro-

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† Phil. Trans. 1767, p. 451.
‡ Id. 1763, p. 84. Priestley, p. 216.
duced, is sufficient to overcome the pressure of the atmosphere, much less that it is sufficient to burst the glass vessels in Bectaria's and Lane's experiments. This is confirmed by Prop. 12. For, let an undercharged body be brought near to, and opposite to the end of a long cylin- drical body, communicating with the ground, the pressure of the electric fluid against the base of the cylinder is scarcely greater than the force with which the two bodies attract each other, provided that the part of the cylinder is undercharged; and consequently, if the spark was produced by the air being pushed aside, by the force with which the fluid endeavours to issue from the cylinder, no sparks should be produced, unless the electricity was so strong, that the force with which the bodies attracted each other was as great as the pressure of the atmosphere against the base of the cylinder; whereas it is well known, that a spark may be produced, when the force, with which the bodies attract, is very trifling in respect of that.

In discharging a Leyden phial, if the two knobs are brought together very slowly, a hissing noise will be perceived before the spark; which shows, that the fluid begins to flow from one knob to the other, before it passes in the form of a spark.

CHAP III.

On the Theory of two Fluids.

The theory of two fluids originated in the discovery made by M. Dufay of vitreous and resinous electricity; and was afterwards warmly supported by our countryman Mr Simmer, who thought that he discovered in the mechanical effects of the electric spark indubitable proofs of two opposite currents. For a long time, however, the question of one or two fluids scarcely occupied the attention of philosophers, who were more solicitous to discover new facts, than to connect together, by any general principles, the scattered phenomena of electricity.

In the theories of Epinon and Cavendish, the doctrine of a single fluid was adopted; but, in order to accommodate this hypothesis to the phenomena, they were obliged to assume, contrary to every physical analogy, that the particles of solid bodies repelled each other with the same force with which they attracted the particles of the electric fluid, or with which these particles mutually repelled each other. From this part of the hypothesis it will follow, that while all the particles of solid bodies are ended with a attractive force diminishing as the square of the distance increases; they are also ended with a repulsive force, following the same law, but infinitely greater in point of intensity, than the attractive force of gravity. This assumption we conceive to be most unphilosophical, as it ascribes to the particles of solid bodies, a new property almost the very reverse of that which they are known to possess; and whatever simplicity may appear in the doctrine of a single fluid, we consider it as merely nominal, and more than counterbalanced by the assumption which is necessary to its existence.

The doctrine of two fluids, which has never been adopted in this country since the time of Simmer, was supported by Coulomb, who has employed it in calculating the various phenomena which he observed.

In this hypothesis it is assumed, that there are two electric fluids, the vitreous and the resinous. The particles of the vitreous fluid repel one another with a force in the inverse ratio of the square of the distance, while they attract the particles of the resinous fluid with a force following the same law; and the particles of the

resinous fluid repel one another, while they attract those of the vitreous fluid according to the same law.

The fine experiments of Coulomb on the distribution of electricity over the surface of conductors, have afforded an excellent opportunity of comparing the theory with observation; and in so far as this has been done, the agreement is very surprising.

Coulomb has demonstrated, both by theory and experiment, that when electricity is communicated to any conducting body, it will be drawn from the interior of the body, and would diffuse itself indefinitely in space, if it were not arrested in its progress by the surrounding air, which, being a non-conductor, will oppose a resistance to its farther diffusion, and force it to distribute itself on the surface of the conducting body, in a thin envelope or coating, the thickness of which will vary in different parts with the form of the body. His demonstration, however, only applies to the case of a spherical body, in which the coating of fluid will be equally thick in every part of its surface.

This part of the theory has occupied the attention of the illustrious La Place, who has applied it to it, La Place, in a most elegant manner, the formula which he employed in determining the figure of the earth. He has shewn, by a method purely synthetical, that, in all ellipsoids of revolution, the electric fluid will distribute itself over their surface, and that the repulsive force of the fluid, or its tension at the pole of the ellipsoid, will be to that of the fluid at the equator, as the polar is to the equatorial axis.

These interesting results have been extended by M. of M. Biot to all spheroids differing but little from a sphere, whatever be the irregularity of their figure. This eminent mathematician has also examined analytically, the law which regulates the losses of fluid sustained by the two surfaces of a jar, or plate of coated glass, when discharged by successive contacts; and has shewn, that the losses of fluid form a geometrical progression. He has also found the same law to obtain in the discharge by successive contacts of a series of jars or plates in a state of mutual communication.

The analytical investigation of this subject has been carried to a very great length by M. Poisson of the Institute of France, a mathematician of the very first eminence, who had already distinguished himself by some improvements on the higher analysis, and by several fine discoveries on some of the most abstruse branches of physical astronomy. We expected, through the kindness of M. Poisson, to have had it in our power to present our readers with a very full account of his important researches; but we believe that the last memoir, which he has drawn up, have not yet been printed. We must therefore content ourselves with giving as copious an abstract as we can of his two recent memoirs on the distribution of electricity on the surface of conductors.

In order to determine in what manner electricity is distributed on the surface of a conducting body, M. Poisson has shewn, that the problem may be reduced to this, to find what ought to be the thickness of the coat of fluid on each point of the surface, in order that the action may be nothing in the interior of the electrified body. If the thickness of the coat of fluid is supposed to be very small, we shall have the distribution of electricity on the surface of a spheroid, differing very little from a perfect sphere. By the application of the formula for the attraction of spheroids, M. Poisson has calculated the attraction of the coating, for a point placed within or without the conductor; and he has found,
In determining the electrical densities of two unequal globes in contact, M. Poisson finds, that the ratio in which the electricity is divided between the two globes, is always less than that of the surfaces; so that, after separation, the mean thickness of the coat of fluid is always greatest on the smallest of the two globes. The ratio between these two thicknesses tends towards a constant limit, which is equal to the square of the ratio of the circumference to the diameter divided by six, which is very nearly as 5 to 3; that is, if a very small spherical conducting body is placed upon an electrified spherical conductor of considerable size, the electricity will be divided between the two bodies, in the ratio of about 5 times the surface of the small sphere to three times the surface of the great sphere.

The experiments of Coulomb, of which we have given a full account in page 452, enable us again to examine the theory by experiment. Coulomb found, that the ratio to which the electrical density constantly approached, was 2.0, which is the same as 6 to 3, while the theory gives the ratio of 1.67, or of 5 to 3. This difference is, at first sight, a little more than might not have been expected; but when we consider the difficulty of determining such a limit experimentally, we shall rather be surprised at the coincidence between the theory and experiment. It ought to be considered, too, that Coulomb always found the ratio below 2, or below 6 to 3; and the highest ratio which he appears, from his Table, to have found, is 1.65; which is almost exactly the same as that obtained by M. Poisson, and is, perhaps, not far from the limiting ratio.

M. Poisson proceeds to apply the analysis to a new case, where these two fluids occur at the same time on the surface of the same body. This takes place in the case of two spheres placed at a distance, which is great when compared to one of the two radii. If the smaller of the two spheres is not electrified directly, but merely from being within the atmosphere of the greater sphere, it will, of course, be possessed of an electricity opposite to that of the great sphere. This electricity accumulates towards the point that is least distant from the great sphere, while the electricity similar to that of the great sphere accumulates on the opposite point. The two opposite electivities on these two opposite points are almost equal; and the neutral line which separates them, almost coincides with the great circle which is perpendicular to the line joining the sectors of the globes, and divides the smaller globe into two equal parts. By means of very simple formulas, the electrical density, and the character of the electricity, may be determined for any part of the two surfaces. This result is confirmed by Coulomb's experiments, so far as they go. See Exp. 5. and 6. col. 2. p. 453.

In his second Memoir, M. Poisson has given the general integrals of the two equations of the problem, first under the form of a series, and then under a finite form, by means of definite integrals. By the nature of these equations, their integrals contain an arbitrary periodical function, which seems to indicate, that the problem is indeterminate, or that the distribution of the electric fluid, in a finite, may depend on these integrals, may take place in an infinite variety of ways. M. Poisson, however, has demonstrated, in a rigorous manner, that this function is foreign to the question, and that the term which contains it ought to be suppressed. After doing this, he obtains series which contain only determinate quantities, and which express the thickness of the coat of fluid, or what is the same thing, the electric density at any point on the two surfaces of the spheres. Except in the case where the two spheres are
very near to one another, these series are very convergent, and as they tend very rapidly to geometrical progressions, it is easy to obtain from them sufficiently accurate values. M. Poisson has calculated tables in the case of two spheres, whose radii are as one to three, and whose surfaces are separated by an interval equal to the smallest of the two radii. These tables contain the thickness of the coating of fluid to less than the 10,000th part, in nine different equidistant points upon each of the two spheres, viz. at the extreme points where the line joining the centres penetrates the surfaces of the spheres, and on other points of the great circles which pass through these extreme points. The simple inspection of these tables shews if the electricity increases or decreases upon one of the spheres, from the point nearest to the other sphere to the most remote point. They shew also whether the electricity is vitreous or resinous, and through what points passes the line of separation between the two fluids. On these different circumstances will depend the total quantities of electric fluid, whether vitreous or resinous, with which the two spheres are charged. We may make the electrical densities of the two spheres of any magnitude we wish, and make them either vitreous or resinous; and if we take one of these quantities equal to zero, we shall have the case where one of the two spheres is electrified solely by the influence of the other, and we shall obtain, at the same time, the reaction of this electrified sphere upon the sphere from which it derives its electricity. When the smallest of the two spheres is electrified by being placed within the atmosphere of the greater one, the latter presents a very remarkable circumstance. The electricity will diminish upon its surface from the point nearest the little sphere to a distance of 67° 30' from that point, and will then increase to the point 180° distant from the point of contact; so that the thickness of the coating of fluid, without changing its sign upon this surface, reaches its minimum about 67° 30'.

In making equal to one another the thicknesses of the coat of fluid which correspond to two different points upon the same sphere, and in determining by this equation the relation between the quantities of electricity with which the two spheres are charged, M. Poisson could produce at pleasure a similar minimum, which will fall somewhere between the two thicknesses which were made equal. By making equal to each other the two extreme thicknesses upon the small sphere, M. Poisson has given another example of this minimum. This particular case is remarkable, as the thickness of the coat is almost constant throughout the whole of the little sphere, and does not vary 1/7th above or below the mean thickness, so that it appears to have experienced no change from its proximity to the great sphere. In this case the electricity upon the surface of the great sphere, passes from positive to negative, and experiences considerable variations of intensity.

The memoirs of Coulomb do not furnish us with any experiments which could be compared with these results excepting experiments 3d and 4th, which we have given in p. 453, col. 2, and which agree with the results obtained by M. Poisson.

The series which represent the thicknesses of the coat of fluid cease to converge when the spheres are very near each other; and in order to apply the series in this case, it is necessary to give them another form, by expressing them in definite integrals. In this way, M. Poisson has transformed them into another series, which becomes more convergent as the distance between the two spheres diminishes. He has thus been able to explain what happens during the progressive approach of the two spheres before contact, and what happens when they are brought into contact, and then separated.

In the first case, the thickness of the coat of fluid at the nearest points upon the two surfaces, increases indefinitely, in proportion as the distance of the spheres diminishes. The same thing is true of the points at which the fluid exercises all the air intercepted between the two bodies; as this pressure is always proportional to the square of the thickness, it ought at last to overcome the resistance of the air, and the fluid in escaping, under the form of a spark, or otherwise, ought to pass, before contact takes place, from one surface to the other. The fluid thus accumulated before the spark, is of a different kind, and nearly equal in intensity upon both the spheres: If they are electrified, one vitreously and the other resinously, it is vitreous upon the first and resinous upon the second; but when they are similarly electrified, positively for example, the sphere, which contains less of the fluid than it ought to have at contact, becomes negative at the point where the spark is preparing itself, and, on the contrary, the sphere which contains more than it ought to have at contact, remains positive over all its surface.

When the two spheres are brought into contact, and then separated to a little distance, the ratio which exists between their total quantities of electricity, causes them to disappear, in the expression of the thickness, the term, which becomes infinitely great for an infinitely small distance. The electricity of the points nearest to each other upon the two surfaces, is then very weak for very small distances: it decreases with the distances, according to a law which M. Poisson has determined. Its intensity is nearly the same upon the two spheres; but when the spheres are unequal, this electricity is positive upon one, and negative upon the other; and it is always upon the smallest that it takes a sign contrary to that of the total electricity.

This result is quite conformable to the experiment of Coulomb formerly mentioned, (Exp. 4. p. 453, col. 2.); and M. Poisson considers it as furnishing an important confirmation of the theory of two fluids. When the two spheres are equal, the electricity during contact and after separation, distributes itself in the same manner upon both. Hence it is natural to think, that in this case the fluid is of the same kind over the whole of each surface, however small be the distance which separates the two spheres. This is in reality what is deduced from the formula, when the radii of the two spheres are supposed equal.

M. Poisson next considers what will take place, in the approach of the two spheres, at the most distant points upon their surfaces. The formula which expresses for very small distances the quantities of electricity relative to these points, shew that the thickness of the coat of fluid which corresponds to them, tends towards a constant limit, in proportion as the two spheres approach one another; and that this limit is the thickness which the coats would have had at the same points, at the instant of contact. These formulas also shew, that the quantity which they represent, converges very slowly to its limit, so that, for very small distances, the electricity of the most distant points upon the two surfaces, still differs much from what it will be in contact, or after the spark. Hence M. Poisson concludes, that the spark, when it takes place at a sensible distance, changes the distribution of the electric fluid over the whole extent of the two surfaces, and even to points diametrically opposite to those where it is produced. (a)
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semitones, S, S, and $f$, (see Plate XXX, Vol. II.) and the octave is made up of $7S + 3S + 2S = V I L L I$. See the Philosophical Magazine, vol. xxxix. p. 414.

Concordant Elements, or elements of harmony, are the three smallest concords; the minor fourth, and major and minor third; 4th + 3rd + 2nd = V I I I. See Concord.

Diatonic of the septime, or system of seven notes; these are the tones major and minor, and the semitone major, T, t, and S in our notation; T, t, and H in Dr R. Smith’s; and G, L, and S in Mr Maxwell’s notation: here $3T + 2T + 2S = V I I I$. See Diatonic Elements.

Of Music, according to Chambers, are T, t, S, and $f$; yet these four elements seem incapable of being all combined together in one octave; but any three of them, except T, S, and $f$, may; and, in these cases,
ELEPHANT.

The Elephant has attracted the attention of mankind from the remotest ages, on account of his size, his strength, and his sagacity. He was considered by the ancients as a powerful engine of war, and is still regarded as a valuable part of the materiel of an eastern army, for the transportation of artillery and baggage, and he forms a necessary appendage to eastern magnificence. His form and manners have often been made the subject of description, and many curious particulars of his history have been detailed by enterprising travellers. Yet still we have cause to regret, that conjecture, in too many instances, has occupied the place of observation, so that qualities have been ascribed to the elephant which he does not possess, and habits to which he is a stranger; and that love of the marvellous has been gratified at the expense of truth, so that the gaudy description of Buffon must yield, in point of accuracy, to the simple narrative of Aristotle. In this article, we shall endeavour to lay before our readers the principal facts in the history of the animal, which appear deserving of notice; unfold the characters of the different species of which the genus Elephas is composed; and then describe the methods employed to obtain him from his native haunts, and to educate him for the service of man.

Sect. I. General Description.

The skin of the elephant is of a dusky black colour, with a few scattered hairs upon it, except on the crown of the head, where they are pretty thick, and are about the length of a hog's bristle. The skin is generally smooth and soft, and only becomes hard and callous, and sometimes knotty, from use or disease. The head is somewhat small in proportion to the size of the body. The forehead is remarkably prominent, and gives to the countenance an expression of dignity and intelligence. The eye is small, quick, and penetrating. The ears are large and pendulous; the back is considerably arched in the middle, and the tail is slender, with a tuft of long hair nearly reaching the ground; the legs are suited to the size of the animal, being thick, strong, and massive, and the foot which is not divided into toes, is furnished with five horny nails on the fore feet, and four on the hind feet.

Among individuals of the same species there appears to be a considerable difference in point of size, as they are known to vary from 7 to 12 feet in height. The dimensions of a full grown male elephant, as measured in India, were as follows:

- From foot to foot over the shoulders: 22. 10\(\frac{1}{4}\)
- From the top of the shoulder, perpendicular height: 10. 6
- From the top of the head, when set up as he ought to march in state: 12. 2
- From the front of the face to the insertion of the tail: 15. 1

The female elephant is always smaller than the male, and, in the Indian species, seldom exceeds eight feet in height. When either males or females are much below this size, they are not considered as of sufficient strength to sustain the requisite burdens. The standard of the Honourable the East India Company, for
The most remarkable organ which the elephant possesses, is its trunk or proboscis, formed by an elongation of the snout, and answering the purposes of a nose. It is sometimes eight feet in length, of a conical form, and composed of muscles entirely at the will of the animal; he can move or bend it, contract, lengthen, or twist it in any direction. The extremity of the trunk terminates in a small protuberance, which stretches out on the upper side, and possesses an astonishing degree of feeling and power. By means of this finger-like protuberance, he can seize, with the greatest facility, the smallest object, lift a piece of money from the ground, or untie the knots of ropes. By means of his snout and trunk, the elephant renders himself most serviceable to man. By his trunk he can raise a considerable weight, and by his snout he can move about pieces of ordnance, and roll away casks. In a wild state, this organ like any other serves the most important purposes. With it he gathers his food, and put it into his mouth, it draws up water to quench his thirst, or to sprinkle his body, and collects dust, which he throws over his skin to keep off the mosquitoes and flies that annoy him. On all occasions he is most careful of his trunk, and unless when tied and picketed he seldom uses it as a means of offence. The males use their tasks for this purpose, and the females endeavour, by falling upon the tiger, to crush him by their weight.

The elephant has no cutting teeth in either jaw in front; but he is furnished with most powerful grinders, that enable him to bruise the vegetables on which he feeds. These teeth, as in all herbivorous animals, have an uneven surface; but do not rise into points as in animals which feed on flesh. The structure of these grinders has excited much attention among anatomists, and led to many important conclusions, which it would be out of place here to enumerate. Each grinder is composed of a number of perpendicular laminae, which may be considered as so many teeth, each covered with a strong enamel, and joined to one another by a bony substance of the same quality as ivory. This last substance being much softer than the enamel, wears away faster by the mastication of the food, so that the enamel remains considerably higher, and, in this manner, the surface of each grinder acquires a ribbed appearance as if originally formed with ridges. From very accurate observations, which have been made on the Asiatic elephant, it appears, that the first set of grinders, or milk teeth, begin to cut the jaw eight or ten days after birth, and the grinders of the upper jaw appear before those of the lower one. These milk grinders are not shed, but are gradually worn away during the time the second set are coming forward, and as soon as the body of the grinder is nearly worn away, the fangs begin to be absorbed. From the end of the second to the beginning of the sixth year, the third set come gradually forward as the jaw lengthens, not only to fill up this additional space, but also to supply the place of the second set, which are, during the same period, gradually worn away, and have their fangs absorbed. From the beginning of the sixth to the end of the ninth year, the fourth set of grinders come forward, to supply the gradual waste of the third set. In this manner, to the end of life, the elephant obtains a set of new teeth as the old ones become unfit for the mastication of his food—a wise provision of nature, where the vast size of the carcass, to be maintained, must require increased exertions of the teeth in the preparation of food.

The milk grinders consist each of four teeth, or laminae; the second set of grinders of eight or nine laminae; the third set of 12 or 13; the fourth set of 15, and so on to the 7th or 8th set, when each grinder consists of 22 or 23; and it may be added that each succeeding grinder takes at least a year more than its predecessor to be completed.

The tusks of the elephant, which correspond with the canine teeth of other animals, are to him most powerful instruments of defence, as, by means of them, he can defend himself, or gore to death the objects of his rage. They are two in number, situated one on each side of the upper jaw. They vary in form and size, according to the age, the sex, or the variety of the individual. In the female the tusks are very small compared with those of the male. The tusks of the male elephant vary in form and appearance. Those called dauntelah, or elephants with large teeth, vary from the projecting horizontal, but rather elevated curve of the pulped or the perfect elephant, to the nearly straight tusks of the wooknah, which point directly downwards. Between these two there is a great variety in the form of the tusks. The largest teeth found in the male elephant are from 5 to 8 feet in length, and from 4 to 8 inches in diameter, and weigh from 20 to 80 lb. each tooth. The increase of the tusks arises from circular layers of ivory, which are supplied internally from the pulp on which they are formed. In some instances, balls have been found in the body of the tusk with which the animal has been shot when young, or, at least, the balls must have entered near the base of the tooth, as they are found imbedded in its hard substance. The temporary, or milk tusks, drop in twelve or sixteen months after birth, and are succeeded by the permanent tusks, which continue growing successively through life.

The elephant seems naturally of a social disposition, and is seldom to be met with alone. The herd, in general, consists of from ten to a hundred of young and old of both sexes. This herd is governed by an aged male and female, and seems to be completely under their direction.

These herds reside in the extensive forests, which they seldom leave, although the males sometimes make predatory excursions to the outskirts in search of more palatable food. Their haunts are seldom at a great distance from a spring of water, or from a river. They avoid the margins of muddy rivers with the greatest care, lest their unwieldy bodies should stick fast in the ooze; and over the large and deep rivers they swim with readiness, to the distance of one or two miles. Their bodies and even heads sink under the water; but, by means of their trunks, which they keep above the surface, they are able to respire, to direct their course, to avoid running foul of one another, and to know, by the smell, the approach of the opposite shore. In sultry weather they frequently spurt water over their bodies, by means of their trunks, and seem equally to avoid the extremes of heat and cold.

When we take into consideration the size of this animal, we need not be surprised at the quantity of food said to be required for his support. A full grown elephant is said to consume, each day, from 100 to 150 pounds weight of vegetables. In his wild state he feeds on grass, shrubs, the leaves and young branches of trees. When a herd of the animals approach the habitations of men, and enter the fields and vineyards in

Elephant.
search of rice, sugar canes, and plantain trees, de-
solation marks their steps. The portion which they
consume is small, when compared with the quantity
which they trample down and crush with their feet.
They appear to give a decided preference to sweet
fruits, and to plants which yield sugar.

The elephant, when young and healthy, lies down
to sleep in the same way as other herbivorous animals
do; but it is believed that, in an advanced period of
life, when the body becomes stiff, he usually takes
his repose in a standing posture, sometimes leaning
on a tree, or other support. When an elephant is first
taken, it is always considered as a good sign when he
lies down to sleep a few months after, as it shows
him to be of a good temper, not suspicious, but reconciled
to his fate; but some elephants have been known
to stand twelve months at their pickets, without lying
down to sleep, though occasionally they took a short
nap standing.

The cries of the elephant are of three kinds. By the
first, which is very shrill, and caused by his trunk, he
expresses his playful humour. The second is a low
note, produced by the mouth, and is expressive of want.
The third is heard when he is roaring, proceeding from the
throat, and indicates irritation or revenge.

It is impossible to ascertain the age to which ele-
phants arrive in a wild state. We may, however, form
some opinion of the term of their existence, by judging
from the circumstance, that, in a state of confinement,
they have been known to live a hundred and thirty
years; and we are probably within proper bounds,
when we fix the extent of the period at two hundred
years.

The sexual connection of the elephant has been the
subject of much discussion. As these animals rarely
copulate in a domestic state, several naturalists have at-
ttempted to account for the circumstance, by ascribing
to the elephant ideas of independence unknown even
to man, supposing them possessed of too much great-
ness of soul to propagate their species in bondage; and
beget a race of slaves; or of too much modesty to suf-
fer any human creature, or even any of their own kind,
to witness their union. But reasons have lately
been assigned why the males seldom show much in-
clination to have connection with the females in a do-

cestic state. When a male elephant is taken in the
prime of life, he is bold and ungovernable, and is not
easily tamed until he is much reduced in body; and
when thus brought low, it requires a considerable time,
the want of attention and experience, before he can
be brought into such high order as is necessary to in-
spire him with thoughts of the other sex. Further,
unless he is of a gentle disposition, and disposed to put
confidence in his keeper, and thus escape the influence
of fear and distrust, he will shew no inclination for
sexual intercourse. But this continent of the elephant,
in a domestic state, has been asserted without proof,
and in direct opposition to the testimony of the ancients.
The Romans collected elephants both from the east and
the south, to accompany their armies, and to add to the
parade of their courts; and they had an opportunity of
witnessing the fertility of these animals in a state of
confinement, as their historians have faithfully recorded.
Aelian says, "Cum Tiberi Caesaris nepos Germanicus,
gadiusque sexus elephanti Romae erat, e quibus aliis pleri-
que generati exitterunt: quorum artus interea dunt
committebatur, et confinabuntur, et membra infirma
conglutinabantur, peritus vir ad pertractandos corum
sensus animosimus mirabilis quodam disciplinae genere
eos erudiebat." Aelian (translation by Conrad Gesner)
de Animal. Nat. lib. ii. cap. 11. Columella more ex-
pressly affirms, "India perhibetur molibus ferum mi-
ribis, pari tum in hac terra (Italy) vastatibus bellus
proceri quis negat, cum interquies nostra natos ani-
madventarum elephantes" De Re Rustica, lib. iii. cap. 8.

These passages appear to have been overlooked by
succeeding observers, and every naturalist, in the ab-

cence of facts, was left to form his own opinion on the
subject. At last an experiment was instituted in India,
by Mr Corse, * whose opportunities were favourable,
and whose talents and habits of observation qualified him
for the task. This gentleman was then Resident at Tipperah,
a province of Bengal, situated at the eastern extremity
of the British dominions in Asia, where herds of ele-
phants are taken every season. He kept a young hard-
some male elephant, of a most docile disposition, and
a favourite female together, in a spacious shade erected
for purpose for their accommodation. In the day
they went out together to feed; they also brought home
a load of such succulent food as their drivers and attend-
ants could collect. After their return they stood to-
tgether, slept near each other, and every opportunity
was granted them to form a mutual attachment. In
the evening they had each ten or twelve pounds of rice
soaked in water, to which a little salt was added; and
from the middle of May until the latter end of June,
some warm stimulants, such as onions, garlic, turmeric,
and ginger, were added to their usual allowance of rice.
Long before this, however, a partiality had taken place,
as was evident from their mutual endearments, and ca-
ressing each other with their trunks, and this without
ceremony before a number of other elephants, as well as
their attendants. "Near the end of June 1793, (says Mr
Corse,) I was satisfied the male would not, even to re-
gain his freedom, quit the object of his regard; I there-
fore ordered the keepers to picket the female by one
of her forelegs only, in the house where they stood, but to
leave the male at full liberty. Fearful, however, of
hurting their supposed delicacy, and thinking the near-
ness and sight of the attendants might possibly give
derogation to their modesty, I desired them to remain
quiet in a little hut erected on the outside of the build-
ing appropriated to the elephants, where they could see
equally well as if nearer. On the evening of the 28th
of June 1793, the male was let loose from his pickets,
and soon after he covered the female, without any diffi-
culty, although before this she never could have re-
ceived the male, being taken when very young, about
five years and a half prior to this period. The male
was then led quietly to his stall; but early on the morn-
ing of the 29th he became so troublesome that the dri-
ers, as they said, in order to quiet him, but partly I
suspect to indulge their own curiosity, permitted him
to cover her a second time, which he readily did before
the usual attendants, as well as a number of other spec-
tators. After this the driver brought me a particular
account of the whole process. Though much pleased

* Now John Corse Scott, Esq. of Sinton, Selkirkshire, and Fellow of the Royal Society, whose excellent observations on the history of
the elephant, published in the Philosophical Transactions, have contributed a number of the most important facts in this article, and whose
subsequent observations in MS. have been kindly submitted to our inspection and use.
It would appear that in a wild state elephants have no particular seasons of love as other animals. The females taken in India, while in a state of pregnancy, produced their full grown young in different months of the year. The female is said to be disposed to receive the embraces of the male before she arrives at the age of fourteen.

Destined to feed on the vegetable productions of the earth, the elephant lives at peace with the other inhabitants of the forest. His gross size and strength renders him an object of terror; as with such power and such sagacity, neither the lion nor the tiger can contend with any prospect of success. Were he to exercise his vast powers in offensive operations, or were he prolific in proportion to his size, he would soon become the master of the wood. But man, even in his rudest state, appears destined to check his progress. Even when untutored by civilization, he kindles a fire, and the elephant retreats in terror; he poisons an arrow, and inflicts a wound which speedily ends in death; or he digs a pit, and the huge monster, unconscious of danger, is suddenly arrested.

The elephant is pursued for the sake of his flesh by the Hottentots of the Cape. When Sparman in his travels at the Cape baited at the Diep river, several Hottentots of the Boshiesman race, who were in the service of the farmer, had their huts, which were composed of straw, covered with large slips of elephant's flesh, cut out irregularly in strings of the thickness of two or three fingers breadth, and strung together to the length of several yards. Some of them were wound round the huts, while others were stretched from one hut to another, for the purpose of drying them. At that time, the men, women, and children in the place, had no other employment but to sleep, smoke, and gormandise upon elephant's flesh. The feet and the trunk are reckoned the most delicious pieces.

As the tusks of the elephant form the well-known article Ivory, a considerable temptation is held out to the huntsman to endeavour to kill these animals. Attempts of this sort appear to be attended with no small difficulty. From two farmers employed in a hunt of this kind, Sparman obtained the following interesting narrative. The evening on which they observed the wild elephant, they determined to pursue it on horseback, though they never before had seen one. Their horses, though equally unacustomed as their riders to the sight of this colossal-like animal, yet did not flinch in the least; nor indeed did the elephant appear to give himself any trouble about them till they came within sixty or seventy paces of him. At that moment, one of the party, agreeably to the usual manner of the Cape huntsmen, jumped from his horse, and fastening the bridle, fell upon one knee, and with his left hand sticking his ramrod into the ground, rested his gun upon it, took his aim, and fired at the elephant, which had then got about forty or fifty paces farther off; for in this country when they hunt the larger kinds of animals, they commonly choose to take the opportunity of firing at the distance of one hundred and fifty paces, both because they load their pieces in such a manner, that the ball, as they think, does most execution at that distance; and also they can in this way gain time to mount their horses again and ride off, before the wounded animal can make up to them to take his revenge. Our sportsman had scarcely got into the saddle, and turned round his horse's head, before he found that the elephant was at his heels. At that very instant, the animal set up a
shrikl piercing cry, which he imagined he felt pierce to the very narrow of his bones, and which occasioned his horse also, to make several hasty leaps, and then gallop off twice as fast as before. In the mean time, the sportsman had sufficient presence of mind to ride his horse up an ascent, well knowing that elephants, and such like heavy animals, are slow and unwieldy in going up a hill in proportion to their weight, and the contrary in descending a hill. He, by this means, not only more certainly distanced his antagonist, but his companion had the more time to advance on one side of the elephant, where he imagined he could most easily direct his shot at the heart and the larger arteries connected with the lungs of the animal. This shot did not, however, hit in any dangerous part, as the horse was rather unruly and pulled at the bridle, which the man had hanging over his right arm, at the instant that he had jumped off his horse and discharged his piece, in the same manner as the former. The elephant now turned upon this last antagonist, but was soon wearied of pursuing him, as the sportsman had an opportunity of riding away from him up a still steeper hill than his companion. The two hunters found that it would answer their purpose better to hold each other's horses, so that they should not get off, while each of the sportsmen fixed their pieces by turns. The elephant, even after the third ball, still threatened vengeance, but the fourth entirely cooled his courage; he did not move a foot, absolutely drop till he had received the eighth. None of the balls, of course, had taken effect in the directly vital parts.

In former times, when the elephant could be employed in battle, a sort of castle was erected on his back, from which missile weapons were thrown; and his sides were armed with sharp-edged instruments, to enable him to force his way through the opposing ranks. But since the invention of gunpowder, this animal has become useless in battle. The fire and the smoke terrify him. But he is still of great utility in transporting baggage of all sorts, and, as a beast of burden, exceeds all others in strength and intelligence. Were it not for the great quantity of food necessary to his subsistence, he would be found a very valuable addition to our western colonies, where land carriage is difficult and expensive.

With regard to the senses of the elephant, he clearly appears to possess, in great perfection, all the five generally enumerated. His eye is quick, and he sees at a considerable distance. His large ear, which he can move backwards and forwards at pleasure, give an additional acuteness to his organs of hearing. Although his skin seems hard, yet insects often annoy him; and the termination of his trunk possesses a delicacy of touch equal to that which belongs to the tips of the human fingers. The sense of smell is probably the most acute of all the other senses of the elephant. When hunting him, the sportsman must be careful to keep on the lee side, otherwise the elephant would soon discover his enemy, and make him suffer for his rashness. Thus Sparrman relates the adventure of one Dirk Marcus, who nearly suffered in the chase. "Once (says this adventurer) in my younger days, when from a hill covered with bushes near a wood, I was endeavouring to steal upon an elephant to the leeward of me, on a sudden, I heard from the lee side a frightful cry or noise; and although at that time I was one of the boldest elephant hunters in the whole country, I must confess that I was in a terrible quaking, insomuch that I believe the hairs on my head stood quite erect. At the same time, it appeared to me as though I had had several pails of water thrown over me; without my being able to stir from the spot, before I saw this huge creature so near me that the weight almost of laying hold of his trunk. At that instant, I fortunately had the presence of mind to take to my legs, and to my no small astonishment, found myself so swift, that I thought I hardly touched the ground. The beast, however, was in the mean time pretty close to my heels, but having at last got to the wood, and crept away from him under the trees, the elephant could not easily follow me. With respect to the place I was in at first, I am certain that the animal could not see me, and consequently that he first found me out by the scent."

In examining the intellectual qualities of the elephant, much caution is requisite in the admission of evidence, as there appears to be a strong desire to ascribe to this animal powers of mind, proportional to his physical strength. Thus he has been praised for uncommon modesty, in opposition to historical evidence, and without the testimony of a single fact. His lofty independence has been extolled, although he is, unquestionably, the most tameable and the most servile brute in the creation; and, in the Hindoo mythology, he is made the representative of the God of Wisdom. The vulgar are ever accustomed to attribute stupidity to animals which have long snouts, as cranes and woodcocks; but when some circumstances tend to elevate the facial line, without augmenting the capacity of the cranium, we fancy we see, in animals of that description, a peculiar air of intelligence. This last circumstance happens in the case of the elephant, where the frontal sinuses swell the cranium to such a degree, that they elevate the facial angle much beyond what the proportion of the brain would require. While the brain in man forms 4/5th part of his whole body, in the elephant it only forms 4/5th part.

It has been stated, that the sagacity of the elephant Memory, is so great, and his memory so retentive, that, when once he has received an injury, or been in bondage, and afterwards escapes, it is not possible, by any art, to entrap him. The following fact, to which Mr C. Scott was an eye witness, will shew how unfounded such speculations are, in which some pseudo-naturalists have indulged:

"In June 1787," (says Mr C. Scott), "Jattra Mugul, a male elephant taken the year before, was travelling in company with some other elephants, towards Chittigong, laden with a tent and some baggage, for our accommodation in the journey. Having come up on a tiger's track, which elephants discover readily by the smell, he took fright, and ran off to the woods, in spite of the efforts of his driver. On entering the wood, the driver saved himself by springing from the elephant and clinging to the branch of a tree, under which he was passing. When the elephant got rid of his driver, he soon contrived to shake off his load. As soon as he ran away; a trained female was dispatched after him, but could not get up in time to prevent his escape; she, however, brought back his driver, and the load he had thrown off, and we proceeded without any hope of ever seeing him again. Eighteen months after this, when a herd of elephants had been taken, and had remained several days in the inclosure, till they were enticed into the outlet, then tied and led out in the usual manner, one of the drivers, viewing a male elephant very attentively, declared he resembled the one which had run away. This excited the curiosity of every one to go and look at him; but when any per-
son came near, the animal struck at them with his trunk, and, in every respect, appeared as wild and outrageous as any of the other elephants. At length an old hunter, coming and examining him narrowly, declared he was the very elephant that had made his escape about eighteen months before. Confident of this, he boldly rode up to him, on a tame elephant, and ordered him to lie down, pulling by the ear at the same time. The animal seemed quite taken by surprise, and instantly obeyed the word of command, with such as much quickness as the ropes with which he was tied permitted; uttering, at the same time, a peculiar shrill squeak through his trunk, as he had formerly been known to do, by which he was immediately recognised by every person who had ever been acquainted with this peculiarity. Thus we see that this elephant, for the space of eight or ten days, during which he was in the enclosure, and even while he was lying in the outlet, appeared equally wild and fierce as the boldest elephant then taken, so that he was not even suspected of having been formerly taken, till he was conducted from the outlet. The moment, however, he was addressed in a commanding tone, the recollection of his former obedience seemed to rush upon him at once, and, without any difficulty, he permitted a driver to be seated on his neck, who, in a few days, made him as tractable as ever.

We shall conclude this account of the sagacity of the elephant, by quoting a few of those stories, which have been commonly related, as illustrative of the degree of intellect which he is supposed to possess, for the purpose of gratifying the general reader.

In India, elephants were once employed in launching of ships. One was directed to force a very large vessel into the water; the work proved superior to his strength; his master, with a sarcastic tone, bid the keeper take away this lazy beast, and bring another in his stead; the poor animal instantly increased his efforts, and, in doing so, fractured his scull on the spot.

In Delhi, an elephant passing along the streets, put his trunk into a tailor's shop, where several people were at work; one of them pricked the end of it with his needle. The beast passed on; but, in the next dirty puddle, filled his trunk with water, returned to the shop, and spurring every drop among the people who had offended him, spoiled their work.

An elephant, in Aden, which often passed through the bazar, or market, as he went by a certain herb woman, always received from her a mouthful of greens. At length he was seized with one of his periodic fits of rage, broke from his fetters, and, running through the market, put the crowd to flight; and among others this woman, who, in haste, forgot a little child she had brought with her. The animal, gratefully recollecting the spot where his benefactress was wont to sit, laid aside his fury, and taking up the infant gently in his trunk, placed it in safety on a stall before a neighbouring house.

Another in Dekan, not having received some arrack which had been promised by the Cornac, or governor, by way of revenge, killed him. The cornac's wife, who was an eye-witness to this, took her two children and flung them before the elephant, saying, "Now, you have destroyed their father, you may as well put an end to their lives and mine." He instantly stopped, relented, took the biggest of the children, placed him on his neck, adopted him for his cornac, and never afterwards would permit any body else to mount him.

A soldier at Pondicherry, who was accustomed, whenever he received his share of liquor, to carry a certain quantity of it to one of these animals, having one day drunk rather too freely, and, finding himself pursued by the guards who were going to take him to prison, took refuge under the elephant's body, and fell asleep. In vain did the guard try to force him from this asylum, as the elephant protected him with his trunk. The next morning, the soldier recovering from his drunken fit, shuddered with horror to find himself stretched under the belly of this huge animal. The elephant, which, without doubt, perceived the man's embarrassment, caressed him with his trunk, in order to inspire him with courage, and made him understand that he might now depart in safety.

A painter was desirous of drawing the elephant which was kept in the menagerie at Versailles, in an uncommon attitude, which was that of holding his trunk raised up in the air, with his mouth open. The painter's boy, in order to keep the animal in this posture, threw fruit into his mouth; but as he had frequently deceived him, and made an offer only of throwing him the fruit, he grew angry; and, as if he had known the painter's intention of drawing him was the cause of the affront that was offered him, instead of revenging himself on the lad, he turned his resentment on the master, and, taking up a quantity of water in his trunk, threw it on the paper on which the painter was drawing, and spoiled it.

Sect. II. Particular Description of the Species.

We come now to consider the situation of the elephant, in the system of nature, to examine the characters of the different species, and point out their physical distribution.

It is but recently that naturalists began to investigate the characters of the elephants of India and Africa, or to suppose that they constituted two distinct species. The ancients, who appear to have used in war animals from both countries, were aware, that the elephants of Africa were inferior both in size and courage to those of India. But the characters which constitute these distinct species, were never pointed out until Camper, from the form of the teeth, proved their title to rank as independent species. The observations of Camper have been still further elucidated by the investigations of Cuvier, who has, besides, added a third species to the genus.

By Linnaeus, the elephant is placed in the order Brute, in the class Mammalia, with the following generic character: "Dentes primores nulli utrinque, Laniatri superiores elongati, Proboscis longissimus, prehensilis, Corpus nudisculsum." By Cuvier the elephant is placed among the Pachydermata, or thick-skinned quadrupeds, in company with the sow, the river-horse, and the rhinoceros. Under this genus are now ranked the following species.


Scull rounded, processes of the enamel in the grinders
forming a series of lozenges touching each other in the
middle; ears large; toes four before and three behind.

The tusks of this species yield the best ivory, and are
the largest in point of size. The tusks of the female
differ but little in size from those of the male. The
ears are very large, and fall back and cover the shoulder.
The hide is of a deep brown colour. The ordinary
height is from eight to upwards of ten feet.
The native country of this species of elephant, is Africa. He inhabits the immense forests and dreary wastes of that extensive continent. In modern times few attempts have been made to bring this species into bondage, or to employ him for any useful purpose. Hence it is, that we know less of the manners of this species than of those of the following, which in the East has long been the slave of man.

Sp. 3. ELEPHAS Indicus. Asiatic elephant. Skull lengthened, forehead concave, enamel of the grinders disposed in the form of flattened ovals placed across the teeth; ears large; horny nails, five before and four behind.

La Menagerie du Museum National d'Histoire Naturelle, 1801, p. 1, tab. 1, 2.

The females of this species, and some varieties of the male, have small straight tusks. The ears are small, and often angular. The hide is grey speckled with brown, and sometimes white. The height from eight to twelve feet.

The elephants in Bengal are divided by the natives into two casts, which they term Koornareah or princely race, and the Merghee or hunting race. The Koornareah is a deep-bodied, strong, compact animal, with a large trunk (which is always esteemed a great beauty in an elephant,) legs short, but thick in proportion to the size of the animal. This variety is preferred, as it is of superior strength, can undergo greater fatigue, and carry heavier burdens than the following. An elephant of the Merghee race, when full grown, is generally taller than the former, but has not so compact a form, his legs are long, he travels fast, has a lighter body, and his trunk is both short and slender in proportion to his height. 'There appears no predilection in any of these elephants to have exclusive connection with his own particular cast, and hence the mixed breed is held in greater or less estimation, in proportion as it partakes of the qualities of the Koornareah or Merghee cast. In some elephants the tusks are large, as in the variety termed the Dauntelah, in which they generally project forwards, and curve upwards. In the variety termed the Mooknah, the tusks are very small and straight, and point almost directly downwards.

An elephant of this species is said to be perfect when his ears are large and rounded, not ragged or indented at the margin; his eyes of a dark hazle colour, free from specks; the roof of his mouth and his tongue without dark or black spots of any considerable size; his trunk large, and his tail long, with a tuft of hair reaching nearly to the ground. There must be five nails on each of his fore feet, and four on each of the hind ones, making eighteen in all; his head well set on, and carried rather high. The arch or curve of his back rising gradually from the shoulder to the middle, and thence descending to the insertion of the tail.

This species inhabits the continent of Asia, and is found on both sides of the Ganges, in China, and in the larger islands of the Indian Ocean. He has long been brought into a state of subjection to man. His manners are therefore very well known, and have been briefly detailed in the preceding general description.

Sp. 3. ELEPHAS Primigenius. Fossil Elephant or Mammoth. Skull lengthened, forehead concave, under jaw obtuse, grinders large, parallel processes of the enamel disposed in closely set ribbands, sockets of the tusks very long.

As many of our readers may be unequainted with this species, which it is highly probable no longer exists in a living state on the surface of the globe, we shall subjoin a few remarks illustrative of its history.

In various parts of Europe, from the shores of the frozen ocean to the Mediterranean Sea, bones and teeth of a large size have, at different times, been dug up. They have been found in alluvial strata of earth, gravel, or sand, generally in valleys, near the mouths of large rivers, and likewise in islands, as Iceland and Great Britain. These bones were at first considered as belonging to an extinct race of giants. But, in proportion, as the science of natural history was cultivated, such ridiculous fables disappeared, and these bones were considered as belonging to the elephant, at that time supposed to be the largest animal which had ever existed. This was an important step in the investigation of these fossil remains, and little else seemed wanting in their history but to account for the means by which they were brought to their present situation. Had they been found only in those countries, which had been conquered by the arms of the Macedonians, Carthaginians, or Romans, it might have been supposed that they had been brought by man to their present situation, since these nations carried along with them a powerful host of trained elephants. But the occurrence of these bones in Iceland, and at the mouths of the rivers of Siberia, clearly proved that these relics were not the remains of elephants slain in battle. The inhabitants of Russia invented a much more simple tale, to account for the occurrence of these fossil relics. They supposed them to belong to an animal, its manners resembling a mole, living under the surface of the earth, and unable to endure the light of day. To this subterraneous animal they gave the name of Mammoth.

Naturalists, finding these explanations merely acknowledgments of the difficulty, and still attaching to the idea of elephant a warm region, fancied that these fossil bones belonged to elephants formerly reared in Asia, and afterwards transported by some violent cause to their present situation. The Deluge was instantly resorted to, and the elephants browsing on the banks of the Ganges, were supposed to have been transported by the flood from their native haunts, and interred in the plains of Europe. But the high state of preservation of these bones, the situation of nearly entire skeletons in beds, formed at different though not remote intervals, and their general distribution over such extensive tracts, forbade the introduction of any torrent to bring them to their present position.

Had naturalists attended more to an examination of facts, the difficulty here complained of would soon have disappeared, and a rational explanation would have been obtained of so curious a phenomenon. It is to the labours of the illustrious Cuvier that we stand indebted for the first accurate observations on the subject. Some approaches to the truth had indeed been made by the labours of other anatomists, who had ascertained that the remains of the elephant found in a fossil state bear a closer resemblance to the bones of the Asiatic than to the bones of the African elephant. Hence some were disposed to believe, that these fossil bones had belonged to individuals of the Asiatic species. But Cuvier has now clearly proved, that the points of difference are so numerous, that the fossil elephant has a title to rank as a distinct species. In the fossil elephant, he ascertained that the teeth are larger in proportion than those belonging to the Asiatic species; that the processes of enamel on the surface of the grinders, are not only more numerous, but less festooned; that the tusks are larger, and more curved; and that the sockets of the tusks are much more produced.
This last circumstance must have influenced the form of the trunk, and given to its base a thickness and size widely different from those of the existing species. Its general height seems to have been little more than the Asiatic species sometimes attains, but its form must have been more rounded and thick.

Viewing all the circumstances in connection, it appears certain that the fossil bones belong to a species of elephant which formerly inhabited Europe in considerable numbers, but which has become extinct, in consequence of the revolutions which the earth has undergone. Nor has this extinction extended to the elephant alone: species of the genus Rhinoceros, Hippopotamus, and Tapir, besides many genera of fishes, shells, and corals, have shared the same fate. The crust of the earth appears to have been inhabited by very different races of beings, during the different periods of its formation and progress. Thus, during the period of the deposition of the flint rocks, the then existing animals appear to have been very different from those which we find in the subsequent formations of chalk and gypsum. And the organic remains which occur in the older alluvial strata, differ from the species which now exist, in form, habit, and geographical distribution.

It may surprise some, perhaps, to be told, that species of the elephant, rhinoceros, hippopotamus, and tapir, animals confined at present to the warmest regions, formerly ranged our forests, and lived on the continent of Europe. But why be deceived merely by the name? The European ox, and the Indian ass, our horse and the African zebra, are species of the same genus, yet they inhabit very different regions. It is not unreasonable therefore to conclude, that the elephants which formerly lived in Europe possessed a constitution and covering which fitted them to dwell on the shores of the Tanis, the Lina, the Rhine, and the Po.

It is fortunate that we are not left to conjecture on this subject. The rhinoceros found on the banks of the Lina, with its skin and part of its flesh preserved, had, according to the observation of Pallas, more hair on one of its feet than is to be found on the whole body of any of the existing species; thus indicating its aptitude to endure the cold of a northern climate. And the following curious discovery of a fossil elephant places beyond a doubt the fact, that it was adapted to live in high latitudes, and endure the rigours of a northern winter.

"In the year 1790, a Tungusian fisherman observed a strange shapeless mass projecting from an ice-bank near the mouth of a river in the north of Siberia, the nature of which he did not understand, and which was so high in the bank as to be beyond his reach. The next year, he observed the same object, which was then rather more disengaged from among the ice, but he was still unable to conceive what it was. Towards the end of the following summer, 1801, he could distinctly see that it was the frozen carcass of an enormous animal, the entire flank of which, and one of its tusks, had become disengaged from the ice. In consequence of the ice beginning to melt earlier, and to a greater degree than usual, in 1802, the fifth year of this discovery, the enormous carcass became entirely disengaged, and fell down from the ice-crag on a sand-bank forming part of the coast of the Arctic Ocean. In the month of March of that year, the Tungusian carried away the two tusks, which he sold for the value of 50 rubles; and at this time (says Cuvier, whose relation we quote) a drawing was made of the animal, of which I possess a copy. Two years afterwards, or in 1806, Mr Adams went to examine this animal, which still remained on the sand-bank where it had fallen from the ice; but its body was then greatly mutilated. The Tuckers of the neighbourhood had taken away considerable quantities of its flesh to feed their dogs; and the wild animals, particularly the white bears, had also feasted on the carcass: yet the skeleton remained quite entire, except that one of the fore legs was gone. The entire spine, the pelvis, one shoulder-blade, and three legs, were still held together by their ligaments and by some remains of the skin; and the other shoulder-blade was found at a short distance. The head remained covered by the dried skin, and the pupil of the eye was still distinguishable. The brain also remained within the skull, but a good deal shrunk and dried up, and one of the ears was in excellent preservation, still retaining a tuft of strong bristly hair. The upper lip was a good deal eaten away, and the under lip was entirely gone, so that the teeth were distinctly seen. The animal was a male, and had a long mane on its neck. The skin was extremely thick and heavy, and as much of it remained as required the exertions of ten men to carry away, which they did with considerable difficulty. More than thirty pounds weight of the hair and bristles of this animal were gathered from the wet sand-bank, having been trampled into the mud by the white bears while devouring the carcass. Some of the hair was presented to our Museum of Natural History, by M. Targe, censor in the Lyceum of Charlemagne. It consists of three distinct kinds. One of these is stiff black bristles, a foot or more in length; another is thinner bristles, or coarse flexible hair, of a reddish brown colour; and the third is a coarse reddish brown wool, which grew among the roots of the long hair. These afford an undeniable proof that this animal had belonged to a race of elephants inhabiting a cold region, with which we are now unacquainted, and by no means fitted to dwell in the torrid zone. It is also evident, that this enormous animal must have been frozen up by the ice at the moment of its death. Mr Adams, who bestowed the utmost care in collecting all the parts of the skeleton of this animal, proposes to publish an exact account of its osteology, which must be an exceedingly valuable present to the philosophical world. In the mean time, from the drawing (says Cuvier) which I have now before me, I have every reason to believe that the sockets of the teeth of this northern elephant have the same proportional lengths with those of other fossil elephants, of which the entire skulls have been found in other places."

The geographical distribution of this species, presents many curious and important facts. Its remains have been dug up in all the countries of Europe from the Mediterranean Sea to the Arctic Circle. In Asiatic Russia they occur in the greatest abundance. They have likewise been found in the European isles, as Iceland, and various parts of Great Britain and Ireland. Its bones have even been dug up in South and in North America, and in Hudson's Bay.

Sect. III. Method of Catching and Training the Wild Elephant.

The elephant has long been disturbed in his native haunts by the enterprising sportman. In Southern Africa, the ignorant Hottentot pursues him for the sake of his flesh, the equally ignorant boor prizes the ivory of his tusks, and the planter regards him as the enemy of his
fields and vineyards. Hence it is that various methods have been devised to gain possession of the unwieldy monster. The savage employs his poisoned arrow, and puts an end to the lingering torture by means of his lance. Where the use of gunpowder is known, the musket is usually made use of; but for this purpose the calibre must be of a considerable size, and, in order to inflict a mortal wound, the ball should strike him a little above the insertion of the trunk. But this kind of sport is attended with the greatest danger, as he is seldom brought dead to the ground, and when slightly wounded pursues with the greatest eagerness, and often with fatal certainty, the author of his pain. The most simple, and probably the most ancient method of catching the elephant, is one frequently employed by savage tribes. A round and deep hole is dug in the earth, near his ordinary haunts, which is carefully covered at the mouth with the branches of trees and grass, by which means the unwary animal is deceived, and falls headlong into the snare. But other methods are resorted to when the elephant is sought after as an animal capable of being trained and formed useful to man. In what manner the ancients recruited the vast hosts of elephants which were attached to their armies, we are at present ignorant. The practice followed at present in the different districts of Asia, and which has obtained for many generations, seems to be the result of an intimate knowledge of the habits of the animal, and appears to be both ingenious and effectual. We propose to lay before our readers a short account of this method, from the interesting paper of Mr. Corse Scott.

Previous to an elephant hunt, which is a work of great labour, a few of the more intelligent and active natives are sent into the forests, for the purpose of discovering the retreats of the animals. They endeavour to ascertain in what direction they range in the greatest numbers, and where they are accustomed to feed. When a herd is discovered, about 300 people are employed to surround it, who divide themselves into small parties, consisting generally of three men, each at the distance of twenty or thirty yards from each other, and form an irregular circle, in which the elephants are inclosed; each party lights a fire and clears a foot-path to the station that is next the herd, by which a regular communication is soon formed through the whole circumference from one to the other. By this path reinforcements can immediately be brought to any place where an alarm is given; and it is also necessary for the superintendents, who are always going round to see that the people are alert upon their posts. The first circle being thus formed, the remaining part of the day and night is spent in keeping watch by turns, or in cooking for themselves and companions. Early next morning, one man is detached from each station, to form another circle in that direction, where they wish the elephants to advance. When it is finished, the people, stationed nearest to the new circle, put out their fires, and file off to the right and left, to form the advanced party; thus leaving an opening for the herd to advance through, and, by this movement, both the old and new circle are joined, and form an oblong. The people from behind now begin shouting and making a noise with their rattles, drums, &c. to cause the elephants to advance; and as soon as they are got within the new circle, the people close up, take their proper stations, and pass the remaining part of the day and night as before. In the morning the same process is repeated, and in this manner the herd advances slowly in that direction, where they find themselves least incommode by the noise and clamour of the hunters, feeding, as they go along, upon branches of trees, &c. If they suspected any snare, they could easily break through the circle; but this inoffensive animal, going merely in quest of food, and not seeing any of the people who surround him, and who are concealed by the thick jungle, advances without suspicion, and appears only to avoid being pestered by their noise. As fire is the thing elephants seem most afraid of in their wild state, and will seldom venture near it, the hunters always have a number of fires lighted, and particularly at night, to prevent the elephants coming too near, as well as to cook their victuals and keep them warm. The sentinels supply these fires with fuel, especially green bamboos, which are generally at hand, and which, by the crackling and loud report they make, together with the noise of the watchmen, deter the elephants from coming near; so that the herd generally remains at a distance near the centre of the circle. Should they at any time advance, the alarm is given, and all the people immediately make a noise and use their rattles to make them keep at a greater distance. In this manner they are gradually brought to the Kedah, or place where they are to be secured. The Kedah is differently constructed in different places. At Tippera it usually consists of three enclosures, communicating with each other by means of narrow openings or gateways. The outer enclosure, or the one next to the place where the elephants are to enter, is the largest; the middle one is generally, though not always, the next in size, and the third or furthest is the smallest; and when in the third or last enclosure, the elephants are then only deemed secure; here they are kept six or eight days, and are regularly, though scantily, fed from a scaffold on the outside, close to the entrance of an outlet, which is about sixty feet long and very narrow, and through which the elephants are to be taken out by one. In many places this mode is not adopted; for, as soon as the herd has been surrounded by a strong palisade, Kaewnees are sent in with proper people, who tie them on the spot in the same manner as is done with the Goondahs, or male elephants that are taken singly. These enclosures are all pretty strong, but the third is the strongest, and has, like the other two, a pretty deep ditch on the inside; and, upon the bank of earth, that is thrown up from the excavation, a row of strong palisades of middle sized trees is planted, strengthened with cross bars, which are tied to them about the distance of fourteen inches from each other, and these are supported on the outside by strong posts like buttresses, having one end sunk in the earth, and the other pressing against the cross bars to which they are fastened. The greatest difficulty is to get the herd to enter the enclosure; for, notwithstanding the precautions taken to disguise the entry, as well as the palisade which surrounds this inclosure, the leader now appears to suspect some snare, from the difficulty and hesitation with which in general she passes into it; but, as soon as she enters, the whole herd implicitly follows. Immediately, when they are all passed the gateway, fires are lighted round the greatest part of the inclosure, and particularly at the entries, to prevent the elephants from returning. The hunters from without then make a terrible noise, by shouting, beating of drums, firing blunt cartridges, &c. to urge the herd on to the next inclosure. The elephants, finding themselves ensnared, scream and make a noise, but seeing no opening ex-
Elephant.

The Kadah or snare.

Except the entrance to the next inclosure, and which they at first generally avoid, they return to the place through which they lately passed, thinking, perhaps, to escape, but now find it strongly barriaded, and, as there is no ditch at this place, the hunters, to prevent their coming near and forcing their way, keep a line of fire constantly burning all along where the ditch is interrupted, and supply it with fuel from the top of the palisade, and the people from without make a noise, shouting and halloing to drive them away. Wherever they turn, they find themselves opposed by burning fires, or bunches of reeds and dried grass, which are thrust through the opening of the palisades, except towards the entrance of the second inclosure. After traversing the first enclosure, and finding no chance of escaping but through the gateway into the next inclosure, the leader enters, and the rest follow; the gate is instantly shut, by people who are stationed on a small scaffold immediately above it, and strongly barriaded, fires are lighted, and the same discordant din made and continued, till the herd has passed through another gateway into the last inclosure, the gate of which is secured in the same manner as the former was. The elephants being now completely surrounded on all sides, and perceiving no outlet through which they can escape, appear desperate, and in their fury advance frequently to the ditch, in order to break down the palisade, inflating their trunks, screaming louder and shriller than any trumpet, sometimes grumbling like the hollow murmur of distant thunder, but wherever they make an attack, they are opposed by lighted fires, and by the noise and triumphant shouts of the hunters. As they must remain some time in this inclosure, care is always taken to have part of the ditch filled with water, which is supplied by a small stream, either natural, or conducted through an artificial channel from some neighbouring reservoir. The elephants have recourse to this water to quench their thirst after their fatigues, by sucking the water into their trunks, and then squirting it over every part of their bodies. While they remain in this inclosure they continue sulky, and seem to meditate their escape; but the hunters build huts around them close to the palisade, watchmen are placed, and every precaution used to prevent their breaking through.

When the herd has continued a few days in the Kadah, the door of the outlet is opened, into which some one of the elephants is enticed to enter, by having food thrown first before, and then gradually further on into the passage, till the elephant has advanced far enough to admit of the gates being shut. Above this wicker gate, two men are stationed on a small scaffold, who throw down the food. When the elephant has passed beyond the door, they give the signal to a man, who, from without, shuts it by pulling a string, and they secure it by throwing two bars that stood perpendicular on each side, the one across the other thus X, and then two similar bars are thrown across each other, behind the door next to the Kadah, so that the door is in the centre. For farther security, horizontal bars are pushed across the outlet, through the openings of the palisades, both before and behind those crosses, to prevent the possibility of the doors being broken. The outlet is so narrow that a large elephant cannot turn in it, but as soon as he hears the noise that is made in shutting the gate, he retreats back wards, and endeavours to force it; being now secured in the manner already noticed, his efforts are availing. Finding his retreat thus cut off, he advances and exerts his utmost force to break down the bars, which were previously put across a little farther on in the outlet, by running against them, screaming and roaring and battering them like a ram by repeated blows of his head, retreating and advancing with the utmost fury. After he has fatigued himself in this confinement, strong ropes with running nooses are laid down, and as soon as he puts a foot within the noose it is immediately drawn tight, and fastened to the palisades. When all his feet have been made fast, two men place themselves behind some bars that run across the passage to prevent his kicking them, and with great caution to his hind legs together, by passing a cord alternately from the one to the other like the figure 8, and then fastening these turns in the middle. A strong rope is now put twice round his body close to his fore legs like a girth, and tied behind his shoulders, then the long end is carried back close to his rump, and there fastened, after a couple of turns more have been made round his body. Another cord is next fastened to the girth, and from whence carried under his tail like a crupper, and brought forward and fastened by a turn or two to each of the girths, by which the whole is connected, and each turn of these cords serves to keep the rest in their places. After this a strong rope is put round his buttocks, and made fast on each side to the girth and crupper, so as to confine the motion of his thighs, and prevent his taking a full step. These smaller ropes being properly adjusted, a couple of large cables with running nooses are put round his neck, and, after being drawn moderately tight, and the nooses secured from running closer, they are tied to the ropes on each side. This operation is represented in Plate CCL. Fig. 5, from an original drawing, communicated by Mr. Corse Scott. While these operations are going on, the other hunters stand before the gate of the passage, tickling his trunk, and diverting his attention with a pike or a bunch of cocoa-nut leaves, plantain leaves, or sugar canes, so that the cords are, in general, made fast without difficulty or opposition. Sometimes, however, he seizes the ropes with his trunk, and endeavours to break them, particularly those with which his feet are tied, or tries to bite them through with his grinders; but the hunters then goad him with sharpened bamboo, or light spears, so as to make him quit his hold. Those who are employed in putting the ropes round his body and over his head, stand above him on a small kind of platform, consisting of a few bars run across through the openings of the palisades, and as an elephant cannot see any thing that is above, and rather behind his head, they are very little incommode by him, although he appears to smell them, and endeavours to catch them with his trunk. When the whole of the apparatus is properly secured, the ends of the two cables, which were fastened round his neck, are brought forward to the outer end of the outlet, where two tamed elephants trained to the business are waiting, and to them these cables are made fast. When every thing is ready, the door at the end of the passage is opened, and the ropes that tied his legs to the palisades are loosened. When an elephant is not very formidable or unruly, it is sufficient to place him lengthwise between two large trees about forty feet distant from each other, there to bind his hind legs in contact together, and fasten them close to one of the trees with five or six turns of thick rope; likewise to bind one fore leg, to which greater liberty is given by the length and slackness of the cordage. The pair of tame elephants are then disengaged from the wild one, and conducted back to the toil to take charge of another captive. This is a most trying moment to the wild elephant. While guided by the tuition, and soothed by the society of his subjugated
brethren, he stands tranquil and quiet, appearing to forget his sorrows, and to gather fortitude under his sufferings; but the instant that his companionsMarch away, finding himself closely bound, a solitary and helpless prisoner, he is agitated with all the horrors of despair, breaks out into a roaring which makes all the forest tremble, and, in the fury of his extravagant grief, often falls a sacrifice to the exertions which he makes to regain liberty. At this moment, coconuts and plantain trees are brought to him for food. In the agony of distress, he tosses them contemptuously away, or tramples them with indignation under his feet. The cravings of hunger, however, at length induce him to eat, which he does at first with evident reluctance, but becomes gradually more resigned, and feeds plentifully at the end of a few hours.

In this manner whole herds of elephants are taken captive; but sometimes a small party of hunters endeavours to seize the males, which often sally forth from the forests alone in search of richer provision. In this object the hunters are frequently successful, by observing the following plan, which is very perspicuously related by Mr. C. Scott. As the hunters know the places where the elephants come out to feed, they advance towards them in the evening with four trained elephants. When the nights are dark, these stragglers are discovered by the noise they make in cleaning their food, by whisking and striking it against their fore legs, and by moonlight they can see them distinctly at some distance.

As soon as they have determined upon the particular elephant they mean to secure, three of the trained females are conducted silently and slowly by their drivers, at a moderate distance from each other, near to the place where he is feeding. These advance very cautiously, feeding as they go along, and appear like wild elephants that had strayed from the forest. When the male perceives them approaching, if he takes the alarm, and is viciously inclined, he beats the ground with his trunk, and makes a noise, showing evident marks of his displeasure, and that he will not allow them to approach near; and if they persist, he will immediately attack and gore them with his tusks; for which reason they take care to retreat in good time. But should he be amicably disposed, which is generally the case, he allows the females to approach, and sometimes even advances to meet them.

When from these appearances the hunters judge that he will become their prize, they conduct two of the females, one on each side, close to him, and make them advance backwards, and press gently with their posteriors against his neck and shoulders. The third female then comes up, and places herself directly across his tail. In this situation, so far from suspecting any design against his liberty, he begins to toy with the females, and caresses them with his trunk. When thus engaged, the fourth female is brought near with ropes and proper assistants, who immediately get under the belly of the third female, and put a slight cord round his hind legs. Should he move at this time it is easily broken, and if he takes no notice of this slight confinement, nor appears suspicious of what is going forward, the hunters then proceed to tie his legs with a strong cord, which is passed alternately, by means of a forked stick, and a kind of hook, from the one leg to the other, as we have before described. A strong cable, with a running noose sixty cubits long, is next put round each hind leg immediately above the cords. These cables are secured in their places by other cords tied round the legs above them. The putting on these ropes generally takes up about twenty minutes, during which the utmost silence is observed; and the hunters, who keep flat upon the necks of the females, are covered with dark coloured cloths, which serve to keep them warm, and at the same time do not attract the notice of the elephant. While the people are thus busily employed in tying his legs, he caresses sometimes one and sometimes another of the seducers, examining their hands with his trunk, and caressing with different parts, by which his desires are excited, and his attention diverted from the hunters, and in these amorous dalliances he is intrigued by the females. He is now generally so firmly secured by the pressure of the tamed elephants on each side, and by the one behind, that he can hardly turn himself, or see any of the people, who always keep snug under the belly of the third female that stands behind, and serves both to keep him steady, and to prevent his kicking any of the people who are employed in securing him; but in general he is so much taken up with his decays, as to attend very little to any thing else. In case of accidents, however, should he break loose, the people upon the first alarm can always mount on the back of the tamed elephants, by means of a rope that hangs ready for the purpose, and thus get out of his reach.

When his hind legs are properly secured, they leave him to himself, and retire to a small distance; but as soon as the females go away he attempts to follow them, but finding his legs tied, he is obliged to a protracted silence, and retreat towards the forest. The hunters now follow at a moderate distance on the females, accompanied by a number of people who had been previously sent for, and who, as soon as the wild elephant passes near a stout tree, make a few turns of the long cables that are trailing behind him around its trunk. His progress being thus stopt he becomes furious, and exerts his utmost force to disengage himself; nor will he then allow any of the females to come near him, but is outrageous for some time, falling down, and gorin the earth with his tusks. If by these exertions the cables are once broken, which sometimes is effectual, and he escapes into the forest, the hunters dare not advance for fear of the other wild elephants, and are therefore obliged to leave him to his fate; and, in this hampered situation, it is said he is even ungenerously attacked by the other wild elephants. As the cables are very strong, and seldom give way, such accidents rarely occur. When he has exhausted himself by his exertions, the trained elephants are again brought near, and take their former positions. After getting him nearer the tree, the people carry the ends of the long cables round his legs, then back and about the trunk of the tree, making if they can two or three turns, so as to prevent even the possibility of his escape. For still further security, as well as to confine him from moving to either side, his fore legs are tied exactly in the same manner as the hind legs were. He is now harnessed with all the expedition possible in the same manner as those already described, and conducted to his proper station.

As soon as each elephant is thus secured, he is left in charge to a keeper, who is appointed to attend and instruct him, and four or five inferior servants, in order to assist and supply food and water, till he becomes so tractable as to bring the former himself. The first object of the keeper is to gain his confidence, and, for this purpose, he constantly supplies him with food, and soothes and caresses him by a variety of little arts. Sometimes, however, the keeper threatens, and even goads him with a long stick pointed with iron, but more
generally coaxes and flatters him, scratching his head and trunk with a long bamboo, split at one end into many pieces, and driving away the flies from any sores occasioned by the hurts and bruises he got by his efforts to escape. The keeper likewise keeps him cool, by squirting water over his body. In a few days he advances cautiously to his side, and strokes and pats him with his hand, speaking to him all the while in a soothing tone of voice, and in a little time he begins to know his keeper, and to obey his commands. By degrees the keeper becomes familiar to him, and at length gets upon his back from one of the tame elephants, and, as the animal becomes more tractable, he advances gradually forward, till at last, he is permitted to seat himself on his neck, from which place he afterwards regulates all his motions. The iron hook with which they direct him is pretty heavy, about sixteen inches long, with a straight spoke advancing a little beyond the curve of the hook. When they wish to turn them, they catch one of their ears with this instrument, and, by pressing it into their skin, make them move in any direction that is required.

While they are training in this manner, the tame elephants lead out the others in turn for the sake of exercise, and likewise to ease their legs from the cords with which they are tied, and which are apt to galls them severely, unless they are regularly slackened and shifted. In the course of five or six weeks, the elephant becomes obedient to his keeper, his fetters are taken off by degrees, and generally in about five or six months he suffers himself to be conducted by his keeper from one place to another. Care, however, is always taken not to let him approach his former haunts, lest a recollection of his freedom once more enjoyed should induce him again to recover his liberty. This obedience to his conductor seems to proceed partly from a sense of gratitude, as it is in some measure voluntary; for, whenever an elephant takes fright, or is determined to run away, all the exertions of the keeper cannot prevent him, even by beating or digging the pointed iron hook into his head with which he directs him. On such an occasion, the animal totally disregards the feeble efforts, otherwise he could shake or pull him off with his trunk, and dash him to pieces. Accidents of this kind happen almost every year, especially to those keepers who attend the large males, and are in general owing to their own carelessness and neglect. It is necessary to treat the males with much greater severity than the females, to keep them in awe; but it is too common a practice among the keepers, either to be negligent in using proper means to render their elephants tractable, or to trust too much to their good nature, because they are thoroughly acquainted with their dispositions.

For further information concerning the history of the elephant, we refer our readers to the following works: Cuvier's papers Sur les Elephants vivans et fossiles, in the Annuels du Musum d'Histoire Naturelle, vol. viii. and to his work on the fossil bones of quadrupeds; La Menagerie du Musum National d'Histoire Naturelle, 1801; Corse Scott's Observations on different Species of the Asiatic Elephants, in the Philosophical Transactions for 1799, Part ii. and to An Account of the Method of catching wild Elephants, by the same gentleman, in the third volume of Extracts from the Asiatic Researches; Cordier's History of Ceylon; the Travels of Sparrman, Vaillant, and Barrow. (1. v.)

ELEPHANTA, a small mountain isle, with a double top, wooded to the summit. It is situated about 5½ miles in an easterly direction from Bombay, and is not more than 3 miles in circumference. Its proper name is Gali Pour; but Europeans call it Elephanta, from the figure of an elephant, as large as life, conspicuous in black stone near the shore, and apparently cut from the rock on which it stands. A neat village near the landing place contains all the inhabitants of the island. They are under British protection, and pay L. 56 annually to the Bombay government.

But the spot is only deserving of notice, from its exhibiting, with the exception of the caves of Ellora, perhaps unrivalled monuments of labour and superstitious zeal. The cave of Elephanta, as it is commonly called, has furnished ample materials for the curiosity and research of the student of eastern antiquities. The mythological symbols and sculpture have been traced to be of Hindoo origin and execution; but their date is lost in fable and obscurity. Whatever mixture of Egyptian or Ethiopian extraction may have been engraven on the stock of Hindoo mythology, undoubtedly the Brahmins can claim a large portion of their system of theology to be of no foreign offshoot, but the result of their own subtility and invention. How vain must it be, at a remote period of time, to attempt to account for the origin and variety of the symbols of worship of a nation sunk in idolatry, since the dreams of enthusiasm, the fictions of poetry, the caprice of princes, the craft of priests, and the boundless powers of human imagination, all conspire to raise and embellish the shrines of superstition, and to propagate delusion and absurdity! We shall give our readers such account of the monuments at Elephanta, as are drawn from the most authentic sources, and relations of travellers who have repaired to the spot.

The cave, about three quarters of a mile from the beach, is approached by an ascent through romantic passes of the mountain, and bursts unexpectedly upon the eye. A spacious excavation in the solid rock of 135 feet in length, by an equal breadth, presents a magnificent spectacle of elaborate sculpture and mythological embellishment. The roof is supported by pillars of the rock left standing; their order is uncommon, but effect agreeable. The reader is referred to the article of CLI. VII. ARCHITECTURE in this work, for a Plate illustrative of part of the interior of the cave. The figures which decorate the walls are in relief so prominent, that they are attached to the rock only by the back. Gigantic forms are observed, some with aspects of benignity, others with looks of terror. Neither in design or execution can the sculpture be compared to the monuments of Grecian art; but it much surpasses in elegance, the Egyptian models, and the bas reliefs from the ruins of Persepolis. The upper extremity of the cave is chiefly distinguished by the profusion of figures. Here the most striking is a bust 13 feet high, of a figure with three heads, expressive of that being of whom the Hindoos had the most sublime conceptions. The middle head represents Brahma, or the creative attribute; the head on the left, Vishnou, or the preserver; and on the right, Seva the destroying, or changing. Brahma's face is represented full, with a look of dignity and composure; his head and neck profusely covered with ornaments. The face of Vishnou is in profile, with, likewise, a complacent regard, and a richly decorated head. One hand bears a lotus flower, the other a fruit resembling a pomegranate; on one of his wrists is seen a ring, as worn by the Hindoos at present. Seva, on the contrary, frowns with a terrific countenance in profile, with projecting forehead, and glaring eyes. Snakes supply the place of hair; and
the representation of a human skull is conspicuous on the covering of the head. One hand grasps a monstrous Cobra di Capella, the other a smaller one; the whole calculated to strike terror and admiration; the length, from the crown of the head to the chin, is 6 feet exclusive of the cap, which is 3 feet more.

The bust, or trimurti as it is called, is entire with the exception of Brahma's two hands, which are quite destroyed. On each side of the bust is seen a gigantic figure leaning on a dwarf, all much defaced. On the right is a large square compartment, loaded with a variety of figures; the largest of which, 16 feet high, is the consort of Seva, represented with one breast. The figure has four arms, the foremost right hand leaning on the bull Nandi, the other grasps a Cobra di Capella, while the inner left hand bears a circular shield. The head is richly decorated. A male, bearing an instrument resembling a trident, appears on the right hand; on the left a female holding a mace or sceptre. Brahna is seen with four heads, sitting on a lotus, while, as it is supposed, Indra and Indrane are represented on an elephant near him. Here Vishnoo with four arms, appears mounted on the shoulders of Garuda. Above this assemblage are seen small figures, in different attitudes, supported by clouds. Corresponding with this niche, is another on the left of the bust. Here two figures are conspicuous, the one a male 14 feet high, said to represent Seva; the other a female 10 feet, who is Parvati his wife. The circular rings, worn by the Hindoo women at present, are seen on the legs and wrists of the female; the mode of braiding the hair the same; and the countenance expressive of gentleness. Vishnoo and Garuda are here portrayed as on the other niche, while the heads of most of the attendant small figures have a whimsical appearance of covering, exactly resembling our wigs. Niebuhr, one of the most intelligent travellers who have visited Elephants, not possessed of that knowledge of Eastern antiquities, requisite to illustrate and explain the sculptures, from his own observation, has drawn conclusions, rather fanciful than just. Of the figure, represented with one breast, he remarks, that it thence appears, that the story of the Amazons was not unknown to the Indians; but this, beyond Niebuhr, we have no reason to support the case. It has been more reasonably deduced, by those acquainted with Indian mythology, that it is intended in this figure, considered as male and female, to represent the active power of Seva, as Bawani or Courage, and as Isani or the goddess of nature. The above ingenious person appears to us not more happy in his conclusion of wigs being of Indian invention. This peculiarity of feature in the symbols, we conceive to be of foreign extraction, and that the sculptor, in merely designing to represent curly and bushy hair, has given them the grotesque appearance of a wig. But these conjectures cannot detract from Niebuhr's general merit as a traveller, who must be regarded as a person of singular intelligence and erudition. But we shall pursue our description of the remaining most remarkable figures.

On each side of the above described groups, is a dark room, or recess, formerly inaccessible to all, perhaps, but the Brahmins; but now in undisputed possession of bats, serpents, and snakes, instigated by clouds. On the left is another group, of which the most remarkable figure is a male, leading a female towards a majestic person seated in the corner of the niche, his head covered like our judges on the bench. The countenance and attitude of the female are expressive of timidity and reluctance. A male urges her forward. Here several small figures are introduced. All the females have ornaments similar to those worn by the Hindoo women at present, round the wrists and legs; the male's ornaments, bearing the same correspondence, round the wrists alone. This resemblance, however, assists us but little in ascertaining the date of the sculptures; the same customs and dress have been in immemorial use among the natives of India, as at this day.

The attention is forcibly arrested by a figure on a niche of equal dimensions with the last, opposite to it, and 50 feet nearer the entrance of the cave. It is a gigantic half length of Seva, or the destroyer, in action, represented with eight arms, and a belt of human skulls around his neck. A right hand grasps a sword uplifted to sever a victim. A Cobra di Capella rises under one arm; a human skull is conspicuous on the head. Small attendant figures are portrayed in distress and pain. Many of the figures are mutilated, as is the principal, whose aspect indicates unrelenting fierceness.

On the other side of the cave, near one of the small rooms above mentioned, are seen Seva and his consort, represented sitting in the manner of the country at this day. A bull reclines at the feet of Seva; in each corner of the niche stands a gigantic guard. On each side of the entrance, is a niche loaded with figures, all much defaced and mutilated. In an apartment, half way up the cave, is inclosed the lingum. The space is entered on the four sides, where are placed eight colossal statues differently decorated. Compartments on both sides of the great cave, separated from it by large fragments of rock, which perhaps formerly composed the roof, present several pieces of sculpture; the most remarkable is Ganesa, or the Hindoo God of Wisdom, with a human body and an elephant's head, such as he is represented in the temples throughout India.

The cave and its decorations appear evidently to be dedicated to Seva the destroyer. A conviction of the harmony of the proportions of these gigantic figures, reconciles the mind to view them with complacency. Many of them were measured by a scale of proportions, allowed to be the most correct; and were found not to deviate more from the standard, than the disproportions which the configuration of the human body deeply presents. Other excavations are in the vicinity, but being still unexplored, they are probably of comparative insignificance.

The islanders, who are said to have fled hither from the opposite island of Salsette, to avoid the persecution of the Portuguese, and who now live in tranquillity under their Banyan tree, say the cave was formed by the gods; nor has a much more satisfactory account yet been traced, than what these simple people give, at least with respect to the date of its construction. Marks of dilapidation and ruin are evident throughout the whole structure. This mutilation is said to have been the effect of the Portuguese cannon, dragged to the spot for the purpose of desolating the shrines of idolatry. How often is the page of the history of nations stained by fanaticism assuming the features of the most sanguinary superstition, while, in the pursuit of the objects of its vengeance, it erases the fairest monuments of art, and abandons itself up to every species of outrage and licentiousness! However characteristic persecution and the sword may be, of the spirit of Mahometanism, they find no sanction from the mild and benevolent doctrines of Christianity.
The cave of Elephantus, like the excavations near Ellora, is the work of a people among whom the arts have attained a high state of perfection. There, labour and skill are displayed in a degree much superior to the theory to construct the pyramids. The one exhibits the toil of barbarous slavery, the other the genius of a civilized and scientific nation. Asiatic literature having been followed through its thousand streams, at this moment, the gods of India stand revealed in their various attributes, almost as clearly as the deities of Greece and Rome; yet has the research failed to deduce science from its parent source, and to reflect much light on the dark page of the history of that splendid era, when Asia eclipsed all nations in works of magnificence and art. Egyptian priests are believed to have come from the Nile to the Ganges, and it may be inferred from the innumerable prejudices and self-sufficiency of the Brahmins, not as their preceptors, but rather to be instructed than to instruct. We know Egypt to have been the fountain of knowledge for the western, and India for the eastern regions of the globe; but which of the two nations can boast of priority of claim to the arts and sciences, remains a doubt. We are ignorant of what the learned of Memphis wrote concerning India, and the sages of Benares give but obscure accounts of Egypt. Indeed, Hindoo testimony, from its preposterous claims to antiquity, is entitled to little belief. We are abundantly warranted in supposing that a connection subsisted between the ancient isolatrons nations, and that Egyptians, Indians, Greeks, and Italians emanated from one central point, from thence scattering their different arts and knowledge, along with themselves, over the world. See Asiatic Researches, vol. iv.; Niebuhr's Travels; and M. Graham's Journal of a Residence in India. (w. t.)

ELEPHANTIASIS. See Medicine.

ELEPHANTOPUS, a genus of plants of the class Syngenesia, and order Polygynia Segregata. See Botany, p. 310.

ELEPHANTUSIA, a genus of plants of the class Polygynia and order Dicciia. See Botany, p. 316.

ELEUSINE, a genus of plants of the class Triandria, and order Monogynia. See Botany, p. 115.

ELEUSINIA MYSTERIES. See Free Masonry and Mysteries.

ELGIn, a royal burgh of Scotland, and the county town of Morayshire, lies upon the banks of the Lossie, about seven miles from where that river falls into the Moray Firth. It is supposed to have derived its name from Helgy, a Norwegian general, who, in the beginning of the 10th century, when Siward, Earl of the Orkneys, spread his conquests over the northern parts of Scotland, is said to have built a town southward of Duffeyrus. This description corresponds with the site of Elgin; and the supposition is farther confirmed by the inscription on the common seal of the town, Sigillum commune civitatis de Helgy. This town consists of one street above a mile in length, intersected by seven smaller streets or lanes; and the houses which front the principal street are generally of three stories. Near the centre of the town, and in the middle of the street, which here widens very much, are huddled together the town-house, the sheriff-court-house, and the county jail; and near to these is the parish church, a low irregular building, all of which both deform and encumber the street. At the west end of the town, on a green mount called Lady Hill, are the ruins of a royal fort. The area within the wall which surrounds the summit of the hill is 85 yards in length by 45 in breadth; and from the remains of the interior buildings, it would seem, that they once formed a square. This fort was destroyed by Robert de Bruce, when he surprised the English garrison which then held it, on his unexpected return from the Hebrides.

Elgin was at an early period erected into an Episcopal see, and was adorned with the palaces of ecclesiastics, and the endowments of monks. The chapel of the monastery of the Grey Friars, is still almost entire, but the monastery itself has been long occupied as the habitation of a private family. The Bishop's palace, now the property of the Duke of Gordon, is but a mean building, and can scarcely be distinguished from the ordinary dwellings. The ruins of the cathedral stand at the east end of the town, and display both magnificence and elegance. This pile is in the form of a cross, 264 feet long, and 36 broad, of Gothic architecture, and stands due east and west. It had five towers; two on the corners of the west end, 84 feet high, exclusive of the steeples; two on the east, 60 feet; and one in the middle, 158 feet. The grand entrance is by the west, through an arched gateway 24 feet high, and 24 feet broad at the base. Above this gate was a window in the form of an acute angled arch, 27 feet high, and 19 wide; and on the east gable was a parallel range of five windows, each ten by two feet; above these, five more, each seven feet high; and over all, a circular window about 10 feet in diameter. On both sides of the church, eastward from the transept, were aisles 15 feet broad outside the walls, having each a large window, and above these a range of windows six feet in height. The whole is richly ornamented with carved devices and embellishments. But the most beautiful part of the building is the chapter-house, which communicates with the choir by a vaulted vestry. It has the form of an octagon 34 feet high, and 27 in its greatest breadth. Its vaulted roof is supported by a clustered pillar nine feet in circumference, from the top of which ribs stretch along the roof to each angle of the octagon. Except where it joins the choir, there is a window on each side; and in the north wall are five stalls in niches for the bishop and dignified clergy. The middle stall intended for the bishop or dean is larger, and raised a step higher than the rest. This cathedral was built by Bishop Andrew de Moray in 1224. In 1590 it was burnt down, together with the town of Elgin, by Alexander, (son of Robert II.) called the "Wolf of Badenoch," in resentment against Bishop Barr. It was soon after, however, restored to its former magnificence, and Bishop Innes laid the foundation of the great tower, and made some other additions to the building. In 1506, the great tower fell, and although Bishop Foreman began to rebuild it in the following year, it was not completed till about 32 years after. The whole cathedral remained entire till 1608, when the council at Edinburgh ordered the lead to be taken from the cathedral churches of Aberdeen and Elgin, and sold for the maintenance of the Regent Murray's soldiers. Being thus uncovered and exposed to the weather, it soon after began to decay, and the great tower fell down in 1711. The remains of a high stone wall still exists, which inclosed the cathedral and burying ground, with houses and small gardens for 22 canons and dignitaries of the see.

Among the buildings of this town, it may be proper to include an intended hospital for the sick poor of the town and county. The funds, now amounting to nearly £40,000, which are to be appropriated to this purpose, were left by Dr Alexander Gray, a native of Elgin, who died some years ago in India. The trustees have already fixed upon a very elegant plan for the
ELICHrysium, a genus of plants of the class Syngenesia, and order Polygama Superfus. See Botany, p. 299.


ELK. This is one of the larger animals inhabiting the globe, belonging to the genus Cervus, and order Pecora of Linnaeus. The history of the elk is involved in considerable confusion, from which we shall find it difficult to lay down its specific characters, as those who have had the most favourable opportunities for observation are scarcely agreed concerning them.

This animal dwells in the north-eastern parts of Europe, in Asia, and North America, chiefly frequenting the colder climates. In the latter country it is called the moose deer, or wapooose by the natives. It is said to consist of two kinds, the red elk or moose deer, which is larger than the tallow horse, and has been seen eight or ten feet high, of a dark grey colour, sometimes black, but much paler on the legs and beneath the tail; the hair is long and coarse, ten or twelve inches in length on the back, and forming a kind of mane on the upper part of the neck. There is a sort of barbule on the excrecence pendent from the throat of some; but it is not ascertained whether this is a general characteristic of the animal, or belongs only to the male. The tail is short, the eyes and ears are large and erect, and the hoofs broad. But the elk is chiefly distinguished by two wide spreading palmed horns of great size, proceeding from the forehead, between two and three feet long, or even between four and five in those of the greatest size; and they have undoubtedly been seen in recent instances, though not so large, yet of such dimensions as to enable us to determine the probability of the fact. The other species is said to be smaller, and of a light grey colour, to herd in flocks of 20 or 30, and to bear more resemblance to the fallow deer; whereas the moose is either solitary, or not to be found with above four or five in company. The motion of the elk is unlike that of the deer; it does not spring on being surprised, it advances with a shuffling gait, while the hoofs make a loud clattering, and runs with great speed. Its food is the herbage of the ground or the foliage of young trees. It dwells on hills or in woody countries, sometimes clustering open pastures in summer, and re- treating to thickets and the banks of lakes or rivers in winter. From the shortness of its neck and length of the legs, declivities are principally frequented, for the ease of reaching the ground. In winter, it prefers willows and some aquatic plants. These animals breed about the month of April, and generally produce two at a time. The males are said to cast their horns annually in November, and to renew them in spring: the females have none, and are besides very different from the males, in being much inferior in size, of a brownish sandy colour, the hair white at the root, and nearly so in some parts of the surface.

The elk is of a quiet, tractable, and docile nature. In summer it is harmless and inoffensive, and it is very easily tamed. When pursuing two crossing rivers and lakes it makes no resistance, and boys or women can easily destroy it. Mr Hearne relates, that he repeatedly saw many as tame as sheep at the settlement in Hudson's bay, and that they would follow their keepers, or come to meet them, in the same manner as the most domestic animal would have done. At New York they have been broke to harness, and apparently not without success. The disposition of the animal renders it particularly favourable for such experiments, and it is not unlikely that it might be naturalized and domesticated in this island.

Of late years a description has been given by Dr Smith of an animal of this genus, which he characterises as the real and genuine elk, and he deduces its characteristics from four individuals, which were exhibited to him in America. The colour, he observes, is reddish in spring; it then changes to greyish dun, afterwards to grey in autumn, and continues so during winter. The rump for six or seven inches from the tail is pale yellow, and separated by a blackish semicircular line from the rest of the body. The fore part of the legs and the nose are black, as also the under lip on each side. A mane about six inches longer than the hair of the rest of the body, and a beard on the throat and breast, are seen on the male in winter. He is provided with horns, which, according to Dr Smith, are not palmed, but consist of three principal divisions, and are cast, all except a pith or core, several inches long, in May. In about eight weeks they begin to grow, and according to the age of the animal a prong successively vegetates from the inside of each alternately. Under the lower angle of each eye is a large external oblique slit, nearly an inch in length, by means of which a whistling noise is produced. Two of the animals were males, and two females; the former had a small vesicle on the external part of each hind leg, containing an unctionous matter, which they can open and anoint the sprouting horns; this was done regularly at four in the morning and at ten at night. These creatures are ordinary vegetables, and readily received tobacco; but as all were domesticated, no inferences could be drawn with regard to their food. At the same time it is said, that in the natural state they feed on the wild plant. All being young, at least not full grown, the extreme limits of their size could not be ascertained; a male, two years old, was 7 feet 3 inches in length; a female, three years old, 7 feet 9 inches long, and 4 feet 7 inches in height; the ear nine inches long, the tail only three. The whole were taken in Upper Canada.

From the preceding description, it appears there is a sensible difference between the real elk of naturalists and those of Dr Smith. The Cervus Pygargus of Pallas, which dwells in Russia, beyond the Volga, seems to bear some resemblance to the latter, in having the muzzle and upper lip black; the tail is only a cutaneous elongation, and the horns are trifurcated. But in other places he speaks of the elk in contradistinction to this animal.
There is a striking peculiarity in the nature of the elk, which has given birth to various conjectures. When sprung by the huntsman, it sometimes suddenly falls down as if in a fit, and then as suddenly recovering itself, sets off at great speed. An opinion has hence prevailed, that it is subject to epilepsy: and a part of the animal’s hoof has been worn as an amulet or charm against that distemper. Horses, it is said, have been seen with the same peculiarity; and we know there are among the smaller tribes of animals, some which counterfeit death on being alarmed.

The elk is hunted in various ways, for the sake of its flesh and skin, and as the fur of wild animals is richer in winter, that season is commonly selected for its capture. The Indians near Hudson’s Bay can easily run it down, for although endowed with sufficient speed, the elk is tender-footed and short winded, so that a good runner will generally tire it in less than a day, and frequently in six or eight hours. However, the huntsman has been known to continue the pursuit two days, before coming up with the game. On occasion the Indians go lightly clothed and loaded, in order to preserve them from fatigue. When the elk can advance no farther, it stands and keeps the pursuer at bay with its head and fore feet; by means of the latter it can kill a dog or even a wolf, and people who suddenly rush upon it, are in danger of serious injury; therefore the Indians who want fire arms, or bows and arrows, stab the animal with a knife fixed to the end of a long stick. This kind of pursuit is much facilitated by the state of the snow; for a heavy animal like the elk sinks deep at every step, when a thaw begins, while the huntsman is kept up by snow shoes on the surface. Snare are also set for the elk; its approach to lakes and rivers is watched, when it is shot with guns or arrows: dogs are likewise used in the chase, and there are various other modes of capture.

The flesh of the elk is good and nutritious, and the skin is converted to various useful purposes. It serves for covering the tent of the Indian, for his shoes, belts, and clothes; in drying, while ladies are bastings of the horns. The skin, when properly dressed, is peculiarly soft and even; but not being prepared with oil, it is said to become hard after having been wet, unless precautions are taken to rub it while drying.

It is probable that some species of these animals are extinct, unless they remain in the recesses of those forests as yet unexplored by the modern races of men. But we know from undoubted evidence, that they once dwelt in countries, even in these islands which we now inhabit, where they no longer exist, nor does any tradition of them now remain. Horns of enormous size are frequently discovered near the surface of the earth, or far below it, which the present elk, though its neck be of great strength, would almost seem incapable of supporting. Nor is it less singular, that such remains are often associated with those of other animals so different in nature, as to render it doubtful whether the living race of both could survive together.

These enormous horns are probably more common in Ireland than elsewhere, and have certainly belonged to a species nearly analogous to that which dwells in the northern regions of the world. Of this description is a pair which Dr Molyneux long ago described in the Philosophical Transactions, measuring 10 feet 10 inches, from tip to tip; each horn 5 feet 2 inches in length, and 11 inches in circumference at the root. Yet the head bore no proportion to these immoderate dimensions, for it was only two feet long, by one in breadth, or just about the size of that of the largest of the elk described by Dr Smith. But these horns do not seem of the largest size, as Mr Parkinson more recently speaks of one 12 inches in circumference at the root. The place of their deposit is usually among alluvial remains. Duvier, a celebrated anatomist, has objected to the fossil horns belonging to the same species as the present elk, because, although palmed like them, the palms are higher from the head, and somewhat of a different figure. But if we are entitled to judge from analogy, the distinctions are not very remote; nay, on strictly attending to the dimensions of the heads which are discovered, inferences might be drawn that the ancient elk of the world was little different from the recent elk in size. See Hearne’s Journey from Hudson’s Bay, Kulin’s Travels in North America. Philosophical Magazine, vol. vi. Philosophical Transactions, vol. xxiv. p. 51. Parkinson’s Organic Remains, vol. iii. Pallay Voyages, tom. i. p. 8. (c)

ELLESMORE, a market town of England, in Shropshire, lies 16 miles north-north-west from Shrewsbury, and 176 north-west from London, and is situated on the margin of a beautiful lake, from which it takes its name. It is a very ancient town, and was formerly very strongly fortified. During the frequent contentions between the English and Welsh in the early period of our history, the castle of Ellesmere became a post of considerable importance, and was held alternately by both nations. The site of the castle, from whence there is a delightful prospect, and a distinct view of nine different counties, is now converted into one of the finest bowling greens in the kingdom. No vestige of the building remains, except three walls and fosses, by which it is still surrounded. It is a neat clean town, but has nothing to boast of except its situation. It contains four well-built streets, a spacious church of an irregular cruciform construction, in the centre of which is a handsome square tower with pinnacles; and the ceiling of the chapel is highly enriched with Gothic fret work. The principal trade of this town consists in malting and tanning, and it has of late derived considerable advantages from the Ellesmere canal, which forms a communication between the river Dee at Chester, and the Severn at Shrewsbury. The lake covers 116 acres; it is well stocked with fish, particularly eels, and its margin is finely wooded. On one side stand the tower, and a house of industry for the poor of five adjoining parishes, and on the other the mansion and park of Oatley.

According to the population in 1811, the town and parish contained,

Inhabited houses ........................................ 1064
Families that occupy them .............................. 1091
Families employed in agriculture .................... 613
Families employed in trade and manufactures .... 452
Males .................................................... 2715
Females .................................................. 2924

Total population .................................. 5659


ELLIPSE. See Conic Sections, vol. vii. p. 130—
144, and Drawing Instruments, vol. viii. p. 130.

ELLPTI MOIONS OF THE PLANETS. See Astronomy Index.

ELLPTOGRAPH, Farey’s. See Drawing Instruments, vol. viii. p. 130. col. 2, and Plate CCXXXVIII. Fig. 2.
ELLORA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 145.

ELLORA, a town of Hindostan, distant about 18 miles from the city of Aurungabad, and six from the fortress of Doulutabad.

The town itself, of no great extent, is situated in a valley, and is chiefly celebrated for its vicinity to works of Hindoo superstition, scattered profusely over the sides of mountains, about a mile to the eastward.

It has not been ascertained to what period these extraordinary efforts of human labour and zeal may be accurately referred, certainly to a date antecedent to the Mahometan conquests in the Decenn, where the dominion of the Hindoo dynasty of princes was paramount, commanding the wealth, resources, and industry, of that populous region of Asia.

In no quarter of the globe has superstition struck its roots deeper, and taken more complete possession of the human mind, than in Asia; scaling the loftiest and most inaccessible mountains, to fix its shrines on their summits, consecrating the gloom of caverns, and impressing its symbols on almost every remarkable tree and stone.

Though the religion of Brahma rejects proselytism, it is well calculated to flatter the passions of the human heart; to allure by the magnificence of its temples, its dazzling processions and ceremonies, to seduce by the mysterious sublimity of its doctrines, to excite wonder by its numberless penances and mortifications, and to command the blind submission and admiration of the multitude by the sacred character of its priests.

These effects are now but partially produced, as the streams of wealth which fed the Indian pagodas, have been diverted into other channels, and swallowed up by the rapacity of conquerors. And though their dark idolatry is still respected, yet we do not scruple to affirm, that the bulwarks of that once inaccessible superstition are gradually undermining, and the character of the Brahmin himself becoming impaired in the eyes of the Hindoo; the receding influence of the Sanscrit language being unfolded, and the veil of mystery which surrounded his mythology, being removed by British intelligence and inquiry. Some of the most celebrated pagodas having fallen under the control of the East India Company, many of the most sensible Hindoos begin to suspect that they are paying homage to the Mammon of the Company, under an incarnation of Vishnu or Seva.

The caves of Ellora must at all times have powerfully contributed to uphold the superstition of the Hindoo, and are not more remarkable for their wonderful construction, than for the durability of materials which have so long resisted the ravages of time, and the persecuting zeal of the Mahometan. The writer of the present article has surveyed these excavations by torch light, and he can declare that the gigantic forms which frowned on the living rock, must inspire amazement in minds not tinctured with superstition. A minute description of them, however, at a remote period of time, from his own observation, cannot be attempted. But information on the subject is not defective. Intelligent travellers have attentively examined them, and communicated their remarks to the public.

The reader is referred to the article Civil Architecture in this work, for a particular description, and for figures illustrative of some of the most remarkable excavations, taken from Sir C. W. Mallat's account, preserved in the 6th volume of the Asiatic Researches.

Sir Charles, when on the spot, endeavoured to ascertain the date of these works, but without success.

We have two authorities stated by him regarding their antiquity and origin, which we shall quote, more for the amusement than the satisfactory information of our readers.

A Mahometan, named Meer Ala Khan, an inhabitant of Ahmednagar, mentions that a person of acknowledged erudition told him, "That the town of Ellora was built by Rajah Eel, who also excavated the temples, and being pleased with them, formed the fortress of Deogur (Doulutabad), which is a curious compound of excavation, sarcophagus, and building, by which the mountains were converted into a fort, resembling, as some say, the insulated temple in the area of Indur Subba. Eel Rajah was contemporary with Shah Momin Arif, who lived 900 years ago."

On the other hand, a Brahmin, an inhabitant of Roza, quotes a book entitled Senna Lye Mahot, or the graces of the mansion of Sewa, i.e. Mahadev, and relates, "That the excavations of Ellora are 7804 years old, formed by Ellor Rajah, the son of Prashant of Eliehoor, when 3000 years of the Dwarpa Yooq were unaccomplished, which added to 4894 of the present Kal Yooq, makes 7804. Eellor Rajah's body was afflicted with maggots, and in quest of cure he came to the famous purifying water named Sewa Lye, or, as it is commonly called, Sewalla, that had been curtailed by Vislum, (at the instigation of Yen-durham, or Jum, the destroying agent), from sixty bow's length (each four cubits square) to the size of a cow's head. In this water Ellor dipped a cloth, and cleansed with it his face and hands, which cleared him of the maggots. He then built Koond, (or cistern), and bathing therein, his whole body was purified; so that looking on the place as holy, he first constructed the temple called Keymas, &c. to the place of Biskurama."

These two authorities are not more remarkable for the coincidence in the alleged projector Rajah Eel, or Ellor, than for their violent discrepancy of date.

Sir Charles, however, discovered, that the excavations are not all of equal antiquity, having traced the more northerly ones to the works of the Sewras or Juttees, who are esteemed schismatics by the Brahmins, and the sect of comparatively modern origin; but this discovery does not ascertain or affect the date or origin of the other excavations, which is lost in fable. No person, in our opinion, who has surveyed these stupendous works, can imagine them the result of individual zeal. The execution of any of them must be considered a prodigious effort of enthusiasm in one person, but when we take them collectively, and view the sides of mountains shaped by the chisel into temples, caverns, and areas of unparalleled size, all loaded with mythological embellishment of the most elaborate workmanship, we can only ascribe them to the zeal of ages, nourished by the wealth and munificence of succeeding princes.

The Koond, or cistern, is extinct just without the town of Ellora. The holiness of its water still renders it a place of resort. A Teerut, or pilgrimage, is performed to it, under the appellation of Sewalla Teerut, or Koond.

The mythological symbols are considered by Sir C. Malet to be purely Hindoo, without any admixture of Egyptian or Ethiopian origin.

But if Sir William Jones's opinion be well grounded, in which we entirely concur, that a connection subsis-
ed between the idolatrous nations of Egypt, India, Greece, and Italy, long before they emigrated to their several settlements, and consequently before the birth of Moses, we may easily suppose them to have borrowed their symbols of worship reciprocally from each other. Thus the remarkable features of resemblance so ingeniously traced by Sir William between the deities of Greece and India will be accounted for.

In executing these works, the chisel appears to have been the only instrument used, as traces of it are visible all over the granite.

They are dedicated chiefly to Mahedaws, the presiding deity, who appears under a two-fold attribute in the temples of India. He is designated the god of destruction, and is conspicuous as the deity who presides over generation, represented riding on a white bull. His celestial seat is Mount Cailasu, every splinter of whose rock is an inestimable gem. On earth, he haunts the snowy mountains of Himalaya, to the east of the Brahmaputra river, called Chandrasichur, or the Mountain of the Moon.

Whoever visits the caves of Elora, while he admires such amazing efforts of industry, must deplore its abuse, in executing works superior in point of labour and skill to the pyramids, and which, like them, can only serve to be perpetual monuments of human weakness and folly. See Asiatic Researches, vol. vi. (w. r.)

ELOQUENCE. See ORATORY.

ELONGATION. See Astronomy.

ELORA. See Elora.

ELSHOLTZIA, a genus of plants of the class Dildynamia, and order Gymnosperma. See Botany, p. 242.

ELSINEUR, Elsinor, or, in Danish, Helsingor, is a town of Denmark, in the island of Zealand; and is situated on the west side of the Sound, almost opposite to Helsingburg on the Swedish side of the Sound, from which it is distant about 3 or 4 English miles. The town of Elsinore is well built, the houses being chiefly of brick, and is regarded as the second town in the Danish islands. It contains two churches; a grammar school; a custom-house, which is a fine building; several handsome private buildings, and a sugar house. In the year 1753 an attempt was made to form a harbour, but it was found to be impracticable. The road-stead, however, is admirable, and generally contains great numbers of vessels lying at anchor. Those ships, which draw only 8 feet of water, can come up to the quays.

The most interesting object at Elsinore is the fortress of Cronberg, which is situated on the edge of a peninsular promontory. The royal palace, within the fortifications, is a magnificent Gothic building of freestone, and of a square form. From an inscription over the gate, it appears to have been begun by Frederic H. and repaired and augmented by succeeding sovereigns. Besides the royal apartments, which are insignificant, it contains the residence of the commandant, a church, a corn magazine, &c. In one part of the castle is a platform, from which the view is magnificent. The Swedish coast, towards the north, is seen for 40 or 50 miles, while the steeples of Copenhagen may be discerned towards the south.

The Castle of Cronberg is strongly fortified towards the shore by bastions and regular entrenchments; and towards the sea by several batteries mounted with 60 cannon, the largest of which are 45 pounders.

Every vessel that passes the port, lowers the topsail and pays a toll, amounting, exclusive of a small duty for the lighthouses, to ½ per cent. on their cargoes, excepting the English, French, Dutch, and Swedish, from whom only 1 per cent is levied. These tolls supply an annual revenue of L100,000 according to Mr Cox, or of L200,000 according to Kuttner. It was in this castle that the late unfortunate Queen Matilda was imprisoned. The only other object of interest at Elsinore, is the Palace of Marienlust, a new but not extensive building belonging to the Crown Prince. It stands on a small steep hill. The garden is called Hamlet's garden, which, according to tradition, is the place where the murder of his father was perpetrated. An account of the shipping of all nations, which paid toll at Elsinore between the years 1792 and 1804, will be found under our article Baltic. Population 5000.

According to trigonometrical observations, Elsinore is situated in East Long. 12° 38' 2", and North Lat. 56° 2' 17". See Cox's Travels in Poland, Russia, Sweden, &c. vol. v. p. 85; Kuttner's Travels through Denmark, Sweden, &c. letter iv.; Catteau Calleville's Tableau de la Mer Baltique, Paris, 1812, tom. ii. p. 324; and Carr's Northern Summer.

ELY, formerly Jelves, is a city and frontier town of Portugal, in the province of Alentejo, situated on a hill covered with olive trees. The streets are irregular and narrow, and so full of dirt, that it is difficult to wade through them, even in dry weather. The town contains four parish churches, and six religious houses, besides a monastery of capuchins without the gate. Elvas is now the third, and most important fortress in Portugal. The town is strongly fortified, and is defended by two citadels situated on the adjacent hills. One of these is called Fort St Luzia. The other was erected by the Count of Lippe Buckeburg, and has, therefore, received the name of a forte de Nossa Senhora de graça de Lippe. The prince of Waldeck considered it as a master-piece of fortification, and as superior to any thing that he had seen. The great aqueduct of Elvas, called os arcos de Amoreira, from its commencing near a mulberry tree, is a very splendid work. It is a Portuguese league in length; and in the neighbourhood of the town, where it passes across a valley, it consists of four rows of arches, one upon another, of a considerable height. Elvas, being the chief town of a corregimento, is governed by a corregedor, a provedor, and a juiz de fora. The hill on which Elvas stands is formed of granite, consisting of white quartz, felspar, and mica, and in some parts containing steatite. On the declivity of the hill, the granite is covered with a whitish grey foliated limestone, with sulphurous pyrites and fehlerz interspersed. Elvas first acquired the name of a city in the reign of Don Manuel, although it is said to have been rehuilt by Don Sancho H. who granted the conditions under which the settlers accepted the lands. The population of the town and district was 12,000. West Long. 7°, North Lat. 38° 44'.

ELY, the name of a town of England, in the county of Cambridge. It is situated on a rising ground on the river Ouse, in the marshy district called the Isle of Ely. The town is of great antiquity, and is supposed to have derived its name either from Elig, from the great number of eels with which the river abounded, or from the Saxon word helig, which signifies a willow, in consequence of the great number of willows which grew in the neighbourhood. The streets are irregular, and excepting the principal one, which contains some good houses, they are neither lighted nor paved. The principal public building in Ely is the cathedral, which was begun in 1093, and finished in 1166. It appears to be a work of different periods, and is a mixture of...
The length of the cathedral from east to west is 535 feet, but the length within is only 517. The transept is 190 feet long, and the lantern 170. The western tower is 270 feet high, and the tower on the south wing 120. The length of the nave is 203 feet, and the height of its roof 1040. Of late years the choir has been removed to the east end of the cathedral, and in 1792 a handsome painted window has been put up above the altar. St Mary's Chapel, now Trinity Church, stands near the east end of the cathedral. It was begun in the reign of Edward II., and is esteemed one of the most perfect buildings of that age. It is 200 feet long within, 45 feet broad, and the vaulted roof 60 feet high. It has neither pillars nor side aisles, but is supported by buttresses surmounted with pinnacles. The Episcopalian palace is built of brick, and the houses of the prebendaries are near the cathedral, and stand on the site of an ancient convent endowed by one of the kings of the East Angles. There is here a free grammar school for 42 boys, besides two charity schools. The inhabitants are chiefly employed in gardening, the adjacent grounds being principally laid out in gardens, which supply the neighbouring towns, and even Cambridge, with vegetables. The following abstract of the population of Ely is for the year 1811, and includes Chesterton in St Mary's Parish, and Stuntney in Trinity Parish.

Number of inhabited houses 928
Number of families that occupy them 944
Families chiefly employed in agriculture 406
Families employed in trade and manufacture 262
Number of males 2,054
Number of females 2,215
Total population 4,249


ELY. See FIFESHIRE.
ELYMUS, a genus of plants of the class Triandria, and order Digania. See Botany, p. 109.
ELYSIUM. See Mythology.
EMBALE, or EMBALM. See Boucic.
EMBALMING, the art of preserving animal bodies from decay after death.

Nature, to make way for her successive generations, has decreed, that the cessation of life shall be followed by the resolution of material substances into invisible fluids. This is accomplished by putrefaction; and no sooner has life departed than its operation begins, quickly reducing the most beautiful works of the creation to a loathsome and corrupted mass; subsequent changes ensue, and, by final decomposition, the animate matter totally disappears. Mankind, reluctant to part with beloved or venerated objects, and actuated by religious principles relative to the welfare of the soul, have devised various methods of counteracting the progress of nature, by preserving their bodies from decay. On remounting to periods of high antiquity, we find the Egyptians, one of the earliest nations whose history has been transmitted to our own times, embalming the bodies of their dead, which were then consigned to appropriate cemeteries, or retained in their dwellings, where they might be the subject of pious contemplation.

The preservation of the dead in the dwellings of the Egyptians, and their interment within its walls, was not peculiar to the Egyptians. In scripture it is said, that Samuel was buried in his house at Ramah; and of Job, that "Benaiah, the son of Jehoiada, went up and fell upon him, and slew him, and he was buried in his own house in the wilderness." Nor are examples of this wanting in modern history, as the Chinese are said to keep the bodies of their relatives long unburied beside them; and some barbarous nations on the coast of Africa inter a deceased relative in the hut which he inhabited.

Embalming, as an art, was carried to great perfection by the Egyptians; it was conducted by persons specially initiated in it, and performed at a costly charge to the survivors. So long as the body remained entire and undisturbed, they believed that the spirit would remain in it after the lapse of thousands of years; and in another respect it was no less important, for a son might pledge the body for his own debt, but it was declared infamous not to redeem it. History even relates, that the bodies of ancestors were exposed to the view of strangers, or produced on ceremonial occasions by postern; and it has been inferred from a passage of Lucian, that he sat at table along with the corpse of an Egyptian.

There were different modes in which embalming was performed, as Herodotus and Diodorus, who both travelled in Egypt at different periods, relate, and they seem actually to have witnessed the fact. According to the former, the decease of any person of distinction was followed by great lamentations of the women; and the men expressed similar symptoms of grief, while they religiously abstained from all pleasures and enjoyments. After these emotions subsided, the body was delivered to the professors of the art, to be prepared according to a fixed price, proportioned to the quality of the deceased. The operator first proceeded to extract the brain through the nostrils by means of a crooked instrument, and filled up the cavity with balsamic ingredients. He next laid open the abdomen, and the intestines being removed, were cleansed with wine and odoriferous substances, and then returned; or they were perhaps thrown into the Nile. The cavity was filled with aromatic matter, and sewed up again. After this the body was deposited 70 days in nitre, and having been removed when these elapsed, it was washed once more, and swathed in fine linen besmeared with gum. The process was now completed after the most expensive method. In another method, a quantity of oil of cedar being injected, and the body laid 70 days as before in nitre, the oil on expulsion brought away the intestines, and the nitre consuming the flesh, left nothing but the skin and bones, whereby embalming was also completed. By a mode still more economical than either, the abdomen was merely washed with certain lotions, and the body then dried 70 days with salt. Diodorus differs from this author, in limiting the period of preparation to 30 days.

From the rapid progress of putrescence in a climate so hot as that of Egypt, it appears, that these operations were immediately subsequent to decease, but with one exception, the origin of which must be sought in the depraved manners of the East. Beautiful women were not committed to the embalmers before the lapse of four or five days after death; and the like interval was preserved with respect to those of rank.

When returned to the survivors, the body had ac-
embalming.

Methods of embalming in Egypt.

required a fragrant odour, every member remained entire, no part had undergone any change; the beauty and appearance of the face were exactly as they had originally been, even the hairs of the eyelids and eyebrows remained in their place. "Thus," says Dio-
dorus, "many of the Egyptians who keep the dead bodies of their ancestors in magnificent houses, see the real features of those who died many ages before they themselves were born, and take as much pleasure in gazing on the countenance of each as if they still lived among them." Probably this is not an exaggerated description, for examples of the same, accomplished both by nature and art, illustrate, that in other cases this has really happened.

It has been remarked, that, contrary to the received opinion, embalment was rarely performed among the Egyptians, and being an expensive preparation, was confined to a few of the more wealthy inhabitants; nor is this disproved by the numerous bodies which for many centuries have been withdrawn from the subterraneous recesses appropriated for their reception, as Egypt was a rich and populous country, and long held a distinguished rank amidst surrounding nations. But notwithstanding the succinct descriptions of Herodotus and Diodorus, the real method of embalment is not easily comprehended by the moderns, for some have doubted the possibility of removing the brain as the former specifies, and others have supposed that the intestines were totally destroyed. Reasoning from ancient history, and from an analysis of different subjects on the Continent, and particularly in these islands, they conclude, that two principal processes were adopted by the Egyptians. In one, the whole members, features, and appearance, were preserved entire; in the other and more general operation, the flesh was consumed, and nothing except the skin and bones retained. Examples of the former, so far as we know, are not now extant, but there are two kinds of embalmed bodies or mummies still obtained in Egypt; those in a dry indurated state completely impregnated with a resinous matter, and whose from the hardness, may be broken in pieces; and those which, with the envelope, are soft and yielding from external pressure, prepared with very little resinous matter, and with nothing but vegetable mould, discoverable in the cavities. It has generally been supposed, that asphaltum or mineral pitch was employed; but more recent experiments prove, that the impregnation of the body was accomplished rather by a resinous substance, and that nitre was the salt employed. Although the flesh unquestionably was, in certain cases, preserved, it seems probable that the body was more usually reduced to a skeleton, and boiled in the resinous or antiseptic matter which was used.

The brain was also, in some cases, effectually removed for a substitute of this nature. Mr. Greaves having laid open the skull of a body, apparently that of one of the more wealthy Egyptians, found two pounds of a medication within it: of the colour, smell, and consistence of pitch or bitumen, which softened in the heat of the sun. But the contents of the abdomen, being commonly reduced to dust, are less easily ascertained. A mummy being dissected by Dr. Hadley in 1768, he found the bones in actual contact with the pitchy matter of the envelope; the tibia and fibula being wrapped up separately. The skull was quite bare in some places, and also in contact with the envelope. There were no remains of flesh or integuments about the head, and the flesh and skin of the extremities were gone. But in the dissection of another mummy, the appearances were very different; for the bandages of the face being laid open, it was evidently covered with a varnish or glazing substance; traces of the eye-lids and eyelashes were perceptible, and the eyes prominent. The ears were not in the least decayed, nor had the cheeks fallen. The whole face was kept firm by a resinous or bituminous composition. The teeth, thirty-two in number, were complete, white, and perfectly beautiful, but the lips had been removed, and the cavity of the mouth filled with an odoriferous dust. The nostrils were stopped with cotton and a kind of ointment, which had also been used in the thorax and abdomen. The hair was short, black, and curled, and could with difficulty be eradicated.

In general, however, nothing but naked bones are found on laying open the mummies brought from Egypt, along with a quantity of vegetable mould occupying what had constituted the thoracic and abdominal cavities, though sometimes the tendons, skin, and fleshy parts remain, and gilding is exhibited on the nails.

In both kinds of embalment, a great portion of pitch or resin was used, experiments tending to show that it was usually the latter. Nevertheless it was not the simple employment of the balsamic matter which completed the process, as the body had then to be swathed in an immoderate quantity of linen fillets or bandages, every member, even to each finger, being separately wound up. This envelope consisted of several folds, each fillet being of different breadths according to the part it encircled. Not less than 300 yards of filleting, according to some writers, or 1000 according to others, were thus employed. After every member was separately bandaged, a general bandage, binding all the parts together, surrounded the body, and the whole was inclosed in an exterior case or covering, on which we now see Egyptian characters or hieroglyphics. All this filleting was deeply impregnated with the resinous or bituminous matter, and has apparently been steeped in it while liquified, and in that state applied to the skin or bones. The art of embalming is thus conjectured to have consisted in the imersion of the body prepared with salt, or the skeleton, in melted pitch or some resinous substance, and in filing the scull, as also the thoracic and abdominal cavities, with some balsamic matter. From an ancient period, this substance has been the subject of anxious research among the bodies of the deceased. Mersin, an Arabic author, relates, that in the year 988 of the Hegira, or 910 of the Christian era, while some Egyptians were digging at the distance of several cubits from the pyramids in quest of treasure, they came to a subterranean vault with niches containing figures standing upright. On breaking them up, mummies were found within. Beside each was a case, including the residue of the substance that had embalmed the body, quite inodorous, but on exposure to heat exhaling a fragrance resembling no other perfume. Abdollatip, an Arabian physician of acute observation, who resided in Egypt in the end of the 15th century, describes the constant prosecution of an active search for treasure in the soil and in the catacombs where the mummies were deposited, of which an ample account has already been given in an earlier part of this work. The Arabs and common people having penetrated the latter, carried away the investments of the bodies, or whatever was impregnated with gum, as he designs it, and sold them to apothecaries. The balsamic substance found in the scull and abdomen was carried to Cairo, and offered to sale for a trifle. "I bought three heads," he adds, "for an Egyptian drachm."
This substance Abdollatiph characterizes as being black like pitch, and emitting an agreeable odour when heated.

The Egyptians did not confine their art exclusively to the preservation of the bodies of mankind. Beasts, birds, fishes, and even serpents, were all embalmed with equal care as their fellow creatures; and apparently the same means have been employed. Birds in particular seem to have been objects particularly favoured; and as they have either been less sought after by the predatory Arabs, or as their various repositories have been more recently discovered, they have reached our present era in greater numbers and perfection than mummies of the human species. The latter were inclosed in coffins made of sycamore, but the animals are usually preserved in pots of earthen ware.

Beside these, the ordinary modes of embalming, it appears that immersion in honey was also practised, although the accounts of it are much more obscure. If we may credit a Roman poet, the body of Alexander the Great, which was entombed in Alexandria, had been embalmed in honey.

Duce et oel. Emathios moneb ubi bellator orbis, Condition hic tales perfumus nectare duce. Statius.

Whatever may be the truth, the operation had apparently succeeded here for several centuries subsequent to the decease of that prince: his body was inspected by several of the Roman emperors, who beheld it entire, and Caracalla remarked a brown on the countenance. Abdollatiph, the Arabian traveller, expresses himself thus: "A person worthy of credit told me, that, during a search for treasure near the pyramids, an oblong close vessel was found. This being opened, appeared full of honey, whereof the party present ate, but some of them soon observing hairs sticking to their fingers, on further examination, discovered that a young child, with a certain jewel or ornament on its body, was inclosed."

In respect to the period when this art fell into disuse among the Egyptians, little evidence can be produced. We have seen that it was known in the most ancient times, that it was practised during the most florishing era of their history; but whether it was gradually abandoned as unnecessary, or lost in the convulsions of the kingdom, as other arts became extinct, we have no other evidence but that of conjecture. Count Cauclus considers that embalming has been discontinued in Egypt since its conquest by the Romans, about the time of Diodorus Siculus; while Blumenbach, a more recent author, supposes, in partial conformity with him, that it has not been practised within a thousand years on those mummies brought to Europe. There is a passage in the works of St Augustine, who lived in the earlier part of the fifth century, which, if literally received, would lead us to infer that embalming was still known in Egypt. Treating of the resurrection he says, Nota nihil ius opponas quasi solus opposeris: non maneat resurrectura crederem, Egydi erit soli credenter resurrectionem, quis diligenter essent evadere moutum. Morum, enim, habent siccum corpus et quasi ame vocare: gabbaras ex vocant. Whether this author speaks from personal knowledge of the fact, or merely from hearsay, cannot now be ascertained.

The customs of the Jews, a cotemporary people, coincided, in some degree, with those of the Egyptians; for we read at an early period of their history, that "Joseph commanded his servants the physicians to embalm his father; and the physicians embalmed Israel: and forty days were fulfilled for him, for so are fulfilled the days of those who are embalmed." Of himself it is said, "So Joseph died, being an hundred and ten years old; and they embalmed him, and he was put in a coffin in Egypt." The practice of the Jews, however, is not so well defined as that of the more polished and civilized Egyptians; for in one of the most specific passages we read, that when Asa died "they buried him in his own sepulchres, which he had made for himself in the city of David, and laid him in the bed which was filled with sweet odours, and divers kinds of spices prepared by the apothecary's art; and they made a very great burning for him." Whether this was chiefly for preservation, or merely the burning of incense in honour of the deceased, does not appear: but in another passage of sacred writ, Jeremiah prophesies of one of the kings, "thou shalt die in peace, and with the burnings of thy fathers, the former kings who were before thee, so shall they burn odours for thee." At a later period of Jewish history, the custom may be more distinctly recognized at the death of our Saviour; because Joseph of Arimathæa having obtained leave too remove his body, Nicodemus brought an hundred pounds of myrrh and aloes, "then took they the body of Jesus, and wound it in linen clothes with the spices, as the manner of the Jews is to bury." There is another ancient nation among which embalming was extensively practised, the Gauches of the Canaries. The history of this people is involved in great obscurity, and their existence is best proved by the remains of their dead, for their posterity is almost if not entirely extinct. The mode of performing embalming is not explicitly illustrated, but apparently the brain and intestines were completely removed, after which it is said the body was washed with an infusion of pine bark. Next, it was anointed with butter or warm grease, which had been boiled along with such penetrating and odoriferous herbs as were peculiar to the country, and then it was exposed to the sun. Being well dried, the same operations were repeated, and also subsequent drying until the body was completely impregnated with the aromatic unguent. When reduced to very inconsiderable weight, the process was deemed complete, and the deceased was wrapped in an envelope, consisting of three successive layers of bandages of tanned buck skin or goat skin about three inches broad. Bodies thus embalmed were carried with funeral ceremonies to caves in a mountain, and there placed in niches upright. Several such caverns or catacombs may be now seen in the Canary Islands, and in some the mummies repose supine, sewed up in goat skins, and still bearing the hair.

We are unacquainted with the antiquity of this treatment, but it was not less effectual than the embalming of the Egyptians. In one of these mummies lately examined, the features of the face were still perceptible: the skin of the whole body was well preserved, dry but pliant, and of a deep brown colour. The hair was very long, black, and in good preservation, though it could easily be detached from the head. In the jaws were thirty-two teeth, so firmly fixed as to require an instrument, or considerable exertion to remove them. The back and belly were covered with hair also in preservation. The scull was empty; but the thorax and abdomen full of grain resembling rice.

Embalming seems to have been practised by the inhabitants of Peru, at the date of the invasion of the Spanish, and was probably known from an ancient period. Acosta mentions the body of one of their sove-
EMBALMING.

It is commonly credited, in which the body had been immersed for preservation; and, on the whole, it was concluded that it had been produced by the dissolution of the body itself. The fact, however, is not clearly proved; and a singular discovery was made about the middle of the preceding century at Rome, in Auvergne, of a body swathed in fine linen, externally imbued with a thick balsam. The extremities were swathed up separately, and the hands and feet inserted into small cases filled with balsam. As the body was quite entire, this balsamic substance, which was extremely fragrant, could not have been produced by any disease of the parts.

Whether the Europeans could actually embalm bodies in equal perfection with the ancient Egyptians, seems to have been a point of controversy in the beginning of the preceding century; but it has been concluded, in the affirmative, and different receipts are given, consisting principally in emptying the cavities, in copious lotions, in partial desiccation, and in the abundant use of aromatic and balsamic substances. We do not here speak of anatomical preparations, for these are of a different kind from what is understood by embalming, and injecting wax into the veins, so successfully practised since the time of Ruysch, the reputed inventor, seems totally unknown to earlier ages. But either by the means of art, or by that aberration which sometimes occurs from the ordinary course of nature, the conservation of human bodies has been complete after the departure of animation. The approaches of death are not always announced by convulsions, nor does a distortion of the features necessarily follow. Examples are seen, where nothing but placed quiescence proves the transition from life, while the mortal remains are preserved from decay. Thus St Jerome says of Paulina, a noble Roman lady, "Quodque mirum sit, nihil pallor mutaverit faciem, sed its dignitas quaedam omnin compleverat ut putaveres non mortuam sed dormientem." "What is surprising, her countenance, not in the least changed by paleness, preserved its dignity, so that she might rather have been thought asleep than dead." In the pontificate of Innocent VIII. about the year 1494, the body of a female was found in a marble sarcophagus at Rome, which must have reposed there for ages, yet the joints were flexible, the flesh was pitted by the touch, and assumed its figure when the pressure was withdrawn. This is not confined to the warmer climates, as repeated examples have proved in these kingdoms. In the year 1497, while some workmen were digging the foundation of a wall within a church of London, they found a coffin of rotten timber, wherein lay the body of a woman "whole of skynne, and of bones undissovered; and the joyntes of her armes playable without breaking of the skynne." An inscription denoted, that it must have lain there above 170 years. In the same city, about the year 1797, three coffins were accidentally laid open at the depth of 18 feet from the surface. One dated 1665, contained the body of a man perfect and soft, just as if breath had departed; another, the corpse of a female, in a similar condition; and the third, that of a child, entire and beautiful as wax-work, the eyes being open and clear. But within twelve hours after their exposure, all these bodies began to decompose, which is an invariable consequence if not counteracted by desiccation. We cannot affirm, that artificial means had been employed in preserving the semblance of life in any of these instances. But in others it has not been wanting. Thus a few years ago, the decay of a wooden coffin at Kyleth in Scotland, having lain open a Leonard one to view, some sacrilegious individuals, in tearing up the latter, removed the
Embalming.—The lid of another included within it. This exposed the body of a female, whose countenance scarcely indicated the cessation of life; every feature was fresh and entire, and the limbs full and perfect as if still animated. At her knee lay an infant, with a glow of colour resembling vigorous health. The surrounding substances were in equal preservation. The shrud was complete, and the ribbands binding it, as vivid in hue as if recently applied. The coffin had contained a liquid, which, now partly evaporated, had become vapid, and odoriferous substances were interposed between the corpses. These proved to be Lady Kilisith and her infant son, who, 77 years before, had been accidentally killed in Holland, and, being embalmed, were sent to Scotland to be entombed. With still greater certainty we know, that an inhabitant of London, to enjoy an amity devised to his wife, in terms equivalent to as long as she should remain upon the earth, had her body embalmed on her decease, and was accustomed to exhibit it with great unconcern to strangers. In another recent instance, where a French officer had lost the object of his warmest affections by sudden death, in the prime of youth and beauty, he caused her body to be embalmed in the most skilful manner. The semblance of life in sleep was restored; even the bloom of animation was preserved. The body was constantly kept in a glass case in his bed-chamber, where it appeared as if only repose.

Although the art of embalming is seldom practised by the more civilized nations, it is not rare among those still comparatively rude. An anxiety to "sleep with their fathers" has animated the greater part of mankind; and where this has been precluded by the perishable condition of decaying bodies, the bones or the heart have been selected for interment in a chosen sepulchre. Thus, if one of the Abiponians, an erratic South American people, should decease at a distance from his principal residence, the body is converted to a skeleton, and carried along with the tribe, until there be a fit opportunity for inhumation. If some of the North American Indians lose a relative on a pressing march, he is interred; but when more at leisure, they return to despoil his bones of the putrid flesh, and convey them to the cemetery of his kindred. Perhaps a similar custom of carrying the bones of their leaders along with them prevailed among the Jews.

At Nukashiwa, one of the Marquessas, we are told by the late Russian circumnavigators, that embalment is practised at the present day. The body of the deceased is washed and laid on a platform, after which it is constantly rubbed during nine months with cocoa-nut oil, to repel putrefaction. By this continued application it becomes as hard as stone, and quite incorruptible. In twelve months, a feast takes place among the survivors, to thank the gods for having permitted the deceased to arrive safe in the other world, when the body is broken into pieces, which, being packed in a small box, is carried to the morai, or burying-place. Captain Cook had previously remarked, that the Otaheitians, by withdrawing the intestines, stuffing the body with cloth, and using cocoa-nut oil, preserved their chiefs a long time for public exposure.

We know that of old, a devout monarch or noble sometimes appointed his heart to be embalmed and transmitted to the Holy Land: or when one died in a remote country, it was frequently inclosed in a silver urn, and sent to the cemetery of his family, which is practised at the present day. Thus urns or cups containing hearts are occasionally discovered in vaults and churches, or even among the family archives long unopened. Such was the fact regarding the heart of Arthur Lord Capel in England, who suffered for his attachment to Charles I.; and very recently the heart of a young nobleman who had many years ago been killed in a duel, was found in the church of Culross in Scotland. It was wrapped in linen, and inclosed in a silver cup with a cover, but had greatly shrunk from its original size.

Somewhat analogous to this subject, is the preservation of the dead by simple desiccation, at Palermo in Sicily. There it is said none of the higher ranks are interred according to the fashion of other European nations, but consigned to the catacombs of a Capuchin convent about a mile without the city. After the performance of a funeral service, the body is dried in a stove heated by a composition of lime, and then placed upright in niches in the subterraneous galleries, clothed in its usual attire. Although they have remained there three hundred years, the flesh dried hard is still upon the bones, but the contraction and distortion of the features exhibit a hideous picture of mortality. The inhabitants pay frequent visits to their deceased friends in this repository, which some years ago is said to have contained a thousand bodies. It is wonderful how little of the animal substance remains in the human frame, thus intentionally or accidentally preserved. A mummy from Teneriffe weighed only 30 pounds; and the body of Robert Burybrough, Bishop of London, who died in 1404, weighed but nine pounds 270 years afterwards.

There are extensive catacombs near the city of Kiow, on the banks of the Dnioper, containing great numbers of bodies in a state of perfect preservation; but it is not known whether they have undergone any artificial process, or how long they have been there, though it has been conjectured that the catacombs were constructed in the tenth century.

Sometimes the progress of corruption is arrested by means which are little understood or explained. The bodies of travellers who perish in the sands of Arabia, or in the snows of the north, frequently remain entire. We have heard that on the hill of Busaco in Spain, the scene of a sanguinary contest a few years ago, some of the bodies of the slain are still seen in preservation. But more permanent preservation ensues with persons who are lost in moses, of which, besides others, a remarkable example occurred in the year 1747. In an extensive morass in the Isle of Axholm, in Lincolnshire, the body of a woman was found lying bent together, on one side, the head and feet almost in contact. From the figure of her sandals, and other circumstances, it was conjectured that her death had taken place 400 years previous to this discovery. It is not animal substances alone which thus resist decay, for nosegays and branches of bays deposited along with the dead, have preserved their verdure for ages.


EMDEN. See EMBRO.

EMBOTHRIUM, a genus of plants of the class Tetrandra, and order Monogynia. See Botany, p. 120.

EMBRYO. See Botany and Physiology.

EMBRYOPTERIS, a genus of plants of the class Diccia, and order Polyantra. See Botany, p. 338.

EMDEN, or EMBRO, a town of Prussia, and capital of the province of East Friesland. It is situated near the lake Dollart, and on the east side of the river Elbe, not far from its mouth. The town is large, strong, and well fortified, and consists of the Old and New Town, with two faubourgs. The principal public buildings are the Hotel de Ville, three Calvinist churches, and places of worship for the Roman Catholics, Lutherans, Mennonites, and Jews.

Emden has long been known as a place of considerable commercial importance. It was declared a free port in 1750 by the King of Prussia, who established here an East India Company, which was, however, abolished in 1759, and replaced by the ancient company for the herring fishery. This fishery employed 60 boats, and produced annually about 1000 tons of herring.

The harbour of Emden is large and commodious, and is capable of holding 400 vessels. By means of a canal upon the Elbe, the ships can come up to the Hotel de Ville. The following statement of the shipping will convey some idea of the state of trade at Emden.

<table>
<thead>
<tr>
<th>Number of Ships</th>
<th>Outwards</th>
<th>Inwards</th>
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<tbody>
<tr>
<td>1781</td>
<td>1025</td>
<td>1004</td>
</tr>
<tr>
<td>1799</td>
<td>2151</td>
<td>2102</td>
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In the year 1784, Emden possessed 273 vessels of the tonnage of 38,578, besides 43 vessels engaged in the herring fishery. In 1804, they employed 500 ships in the carrying trade alone. Linen cloth and hosiery are manufactured here, but to no great extent. The population of the town in 1785, was 7908, without reckoning the garrison; in 1802, the inhabitants amounted to 16,400. According to trigonometrical observations, Emden is situated in East Long. 7° 10' 1", and North Lat. 53° 22' 3". (w)

EMERALD. See Oryctonosy.

EMERSON, William, an eminent mathematician, was born on the 14th May 1701, at Hurworth, near Darlington, in the county of Durham. His father, Dudley Emerson, who appears to have been possessed of some little property, taught a school, and seems to have been a person of some information and genius. From him William received the rudiments of his education in reading, writing, and arithmetic, and a little Latin, perhaps as far as the Cordery or Beza's Latin Testament. It appears that he made some further progress in the learned languages afterwards, and received assistance in acquiring them from a young clergyman, then curate of Hurworth, who was boarded at his father's. In his early days he appears to have been idle and inattentive, and exhibited none of those symptoms of superior genius for which he was afterwards so remarkable. Indeed, so careless and inattentive to learning was he, at this period, that he was frequently heard to say, till he was nearly twenty years of age, that his principal and favourite employment for one season of the year, was looking after birds nests. But his attachment to childish amusements was soon to pass away, and as he advanced in years, his mind began to relish, and to be sensible of the charms and beauties of science. He went first to Newcastle, and afterwards to York, where he applied himself with considerable attention and diligence to the study of the mathematics, under the directions of schoolmasters whose names he always mentioned with respect. He used also to say, that his father was a tolerable mathematician, and without his books and instruments, his own genius would, perhaps, never have been unfolded. After his return from York he resided principally at Hurworth, where he continued to pursue his studies and amusements at intervals, till the time of his marriage, which happened about his 32d year. From this period we may date the commencement of his mathematical labours, or, perhaps, rather the communication of them to the public. What he had done before in this line was merely an occasional application for his own amusement, or for the exercise and employment of his leisure hours. But one of those accidents, which, Dr. Johnson observes, produce that particular designation of mind, and propensity to some certain science, commonly called genius, took place on this occasion, and added a powerful stimulus to his native thirst for knowledge and for fame. His wife was the niece of a Dr. Johnson, rector of Hurworth, vicar of Manfield, in the county of York, and a prebendary of Durham. A man, who, by practising surgery, and from the emoluments arising from his livings, had accumulated a considerable fortune.

Johnson had promised his niece, who lived with him, five hundred pounds for her marriage portion. Some time after the marriage, Mr. Emerson took an opportunity to mention this matter to the Doctor, and to remind him of his promise. The Doctor, who appears to have been a man destitute of honour with regard to his word, did not choose to recollect any thing of the matter, but treated our young mathematician with some contempt, as a person of no consequence, and beneath his notice.

Emerson's independent mind could easily have surmounted pecuniary disappointment, his patrimony, though not large, being equal to all his wants, but this contemptuous treatment excited his indignation. He went home, packed up his wife's clothes, and sent them off to the Doctor, swearing, at the same time, that he would scorn to be beholden to such a fellow for a single rag, adding, with great vehemence, that he would prove himself the better man; and, in order to demonstrate this, he determined to labour till he became one of the greatest mathematicians of the age.

Emerson made himself a perfect master of the whole circle of the mathematics; and having carefully planned and digested the work to his own satisfaction, he published, in the 42d year of his age, his book of Fluxions, and at his first appearance as an author, he obtained a respectable place among contemporary mathematicians. Having thus secured his fame upon a firm and solid basis, he continued from time to time to favour the public with other valuable publications, on several branches of the mathematics, a list of which may be seen in an excellent and well written account of his life, by the Rev. W. Bowe, prefixed to his Tracts, from which the chief
part of this account is taken. He was also a frequent correspondent to the Ladies Diary, a work which has greatly contributed to the diffusion of mathematical knowledge, and added a stimulus to youthful exertion.

Emerson was, in person, somewhat below the middle size, but firm, compact, and strong; his face was of an open countenance, with a rude and complexion, a keen penetrating eye, and an air of eagerness of look that was very expressive of the texture of his mind. His dress was simple and plain, or, perhaps, some might say slovenly and grotesque; but Emerson was a man of independent mind, and, therefore, was no way uneasy about the appearance he might make in other people's eyes — he knew his own value as a man, and disregarding the opinion of the superficial observer, who places all worth in outward appearances, he claimed kindred, and wished to be ranked only with the intellectual nobility. His diet also was as plain and simple as his dress; and his meals gave him little interruption in his studies, employments, or amusements. During his days of close application he seldom sat down to eat, but he would make a cold pie, or make up any kind in his hand, and retiring with it to his place of study, he satisfied his appetite for knowledge and food at the same time. And when his stock of groceries, or other necessaries in the article of house-keeping, run low, on Monday morning he took his wallet, which he flung obliquely across his shoulders, and set forward to the market of Darlington, three miles distant, and after providing the necessary articles, he would set himself contentedly down in some public house for the remainder of the day, and frequently for the night too, sometimes not returning home till late on Tuesday or Wednesday: he remained talking or disputing on various topics, mechanics, politics, or religion, according to his company. Being seldom possessed of any stock of ale at home, he would sometimes indulge in these protracted potations at Hurworth, and he was always remarkably exact in appportioning each man's share of the reckoning.

His style in conversation was generally very abrupt and blunt, and often ungrammatical, and this led many people to suppose that he could not write his own papers; but this was no rule to judge by, as we cannot with any degree of certainty determine how a man will write from his conversation. It will ever be a lasting reproach to the rich and great of his day, that such a man as Emerson was suffered to end his days in obscurity. It is true he possessed a small farm, which rendered him in some measure independent; but his abilities deserved greater encouragement, and it is probable his name would scarcely have been known in the republic of letters, but for the friendship of Mr Montagu, who first recommended him to that eminent bookseller Mr Nourse of London, who engaged him on very liberal terms, to furnish a regular course of the mathematics for the use of students. It does not appear that he was very anxious about literary distinctions or titles: He did not wish to be admitted a fellow of the Royal Society, because, he said, it was a hard thing that a man should burn so many farthing candles as he had done, and then have to pay so much a year for the honour of F. R. S. at his name. Emerson, like other men, had his foibles and defects. He was singular and uncouth in his dress and manners, and hasty and impetuous in his temper. But whatever failings he had, they were more than overbalanced by his virtues. He had a firm and independent mind, that could not be brought to submit to anything mean, base, or ingenious; a pure, genuine, and ardent love of truth, and a detestation of falsehood of every species. His honesty and integrity were such, that all who knew him reposed in him the most implicit confidence, and no man could ever justly complain that Emerson had deceived him.

His abilities as a mathematician will not rank him amongst those of the first class. Though he cannot be said to have added any remarkable discovery to the science, yet when we take into consideration the many valuable works which he has written, and the astonishing progress which he made in every branch of the mathematics, perhaps without any assistance but the exertions of a vigorous mind, we cannot fail to regard him as a mathematician of wonderful acquirements, and as entitled to the gratitude of posterity: He died May 21, 1782, and lies buried in the churchyard at Hurworth, at the west end of the church, against which is erected to his memory a stone, with a short Latin inscription; but his works furnish a more splendid, as well as a more durable monument to his memory and fame. For a more detailed account of the life of this celebrated mathematician, and of his works, see his Treats, new edition, printed in London, 1793, by F. Wigrave. (q.)
their migrations were frequent, but they were not extensive, and a large river, an extensive desert, or an arm of the sea, commonly proved limits to them.

The ancient inhabitants of many of the temperate regions of the globe were accustomed to such easy migrations; and these have been also practised, in modern times, by the tribes that occupy the vast plains of Tartary.

The frequent passage of trading parties and caravans, through a country peopled by such wandering hordes, has proved a temptation to robbery, and Lis added this feature to the character of many of the Arab tribes.

Emigration to remote countries is an occurrence more serious, being accompanied with greater danger and difficulty. It is particularly affecting when those who emigrate have no expectation of again returning to their native land; yet there is evidence of many such occurrences in remote ages, and the discovery of the New World has rendered them frequent in latter times.

The local attachments of the natives of Switzerland are so remarkable, as to have become proverbial; yet, in former times, the people of that country deliberately resolved to abandon it, and persisted in that resolution. Ambition had led a distinguished individual to exert his influence among them, for the forming of this resolution, but they persevered in it after he was gone, and were prevented only by the superior discipline and power of the Roman people. In altered circumstances, it therefore appears, that in the same country, the people, in general, may possess the strongest local attachments, or may become resolved on a general emigration.

By this it appears, that moral causes may induce a nation to emigrate, and that political influence may be employed extensively and successfully with this view. Natural causes do not appear to be so prevalent, though it cannot be doubted that their influence may have some effect. The Swiss and the Scottish Highlanders inhabit the most rugged countries in Europe, and yet they possess as warm attachments to their native lands as any nation on earth; but the Swiss occasionally quit their country, to serve in small bodies as warriors in other lands. And frequent emigrations have taken place from the Highlands of Scotland without any hope or prospect of return.

For these vast migrations of brave yet barbarous nations, by which the Roman empire was overwhelmed, we may assign very natural causes. The Romans had become a wealthy and a dissipated, and they were therefore a degenerated people. Their luxury and weakness at once tempted and encouraged their invaders, who emigrated in great multitudes, hoping to obtain at one time the glory of conquest, and settlements in a richer and better country.

Accident seems to have sometimes opened a way for emigration. The occasional passage of some river or sea, of some forest or desert, or chain of mountains, which had served as a barrier, has opened a way at one time to the noble spirit of discovery, and the insatiable spirit of cupidty and ambition. Exaggerated reports have commonly been made of the new discovered country, and if these have been employed in artful hands, in order to excite emigration, great effects have taken place.

Savage tribes have often been driven to emigrate by war. Jealousy of their liberty, and wanting only a suitable extent of territory in which they may live by the chase, they can readily remove out of a land in which they possess no cultivated fields, and no dwelling but such as are slight and temporary. This view of things furnishes an explanation of the numerous, extensive, and yet seldom recorded migrations which have taken place among the tribes of North and South America.

The spirit of colonization was nearly as ardent among the commercial and powerful cities of antiquity, as it is in modern times; but the means of gratifying that spirit were more limited. If the use of the mariner's compass had been known, discovery and colonization must have extended themselves much earlier over the world. It is rather to be wondered at, that occasional storms and other accidents had not earlier and more widely conveyed the knowledge of nations to each other; but while the ocean intervened, and seems durst not venture to sail much beyond the sight of land, extensive emigrations to remote parts were not practicable.

That considerable migrations, notwithstanding those difficulties, have occasionally taken place, is believed on grounds apparently good. Whatever it may be that has impressed a strong and easily discriminated character on the different races of mankind, it seems undeniable that some of these races which belong to one quarter of the globe have found their way into another. History does not record the time, nor the means of these migrations; but an established resemblance in features, in stature, and complexion; in habits also, and even in language, appears demonstrative of the fact.

Few subjects of discussion can be more interesting than it would be to trace the causes and means of such migrations; but as neither the moral, nor the natural, or political causes of such events can now be certainly ascertained, it seems better to restrain curiosity within due bounds, and to attend particularly to events which cannot fail to be interesting in this kingdom, especially to those parts of it from which emigration has most frequently and extensively drained away the inhabitants.

Very discordant and even opposite opinions are held by different persons, with respect to the causes and the consequences of emigration from the Highlands of Scotland. The author of this article has long attended the subject; he has no disposition in these matters to gratify, no interest to promote, and no end to accomplish, the views that he submits he conceives to have been fairly impartially formed.

Many of the Scottish Highlanders resort to the different colonies of Great Britain, with a view to employment or fortune; and many betake themselves to the lower districts of Scotland, or to England, and reside mostly in the chief towns, or cities, with similar views.

It is not to these persons, however numerous, that this article is intended to apply: They have migrated as individuals for private objects; and their choice of a place of residence, or mode of employment, is not an object of public attention. In many respects, their migration has been productive not only of private but of public advantage.

But when vessels are hired and chartered, for the purpose of conveying great bodies of emigrants from a country but thinly peopled; and when the destination of these is to remote countries, to which it is often difficult for them to procure a passage, and from which there is no prospect of their returning,—the matter becomes, in no slight degree, interesting to the public.

The history of emigration from the Highlands of
Scotland, the cause of it, the consequences, and the means of prevention if such exist, appear to demand particular notice.

An historical view of Scotch emigration, would not go back much above half a century. The discovery of the vast regions of America, was accomplished ages before they could be colonized. Few attempts are attended with more difficulty than the peopling of a distant wilderness. The superior wealth and population even of England, stimulated by a spirit of enterprise, and countenanced by the sovereigns of her distinguished country, made subsistence in a mode which proved abortive a gross want of knowledge of those remote countries, and perseverance, at last succeeded.

The Scots disappointed and indignant at the fate of their favourite colony of Darien, were not soon or easily induced to embark in any similar design; and it is not probable that emigration would afterwards have taken place from that country on a large scale to America, if there had not occurred a great alteration in the mode in which lands were let and occupied in the Highlands.

The introduction of sheep-farming on the great scale into that part of Scotland, undoubtedly occasioned the removal of a great proportion of the inhabitants. Whether this effect was unavoidable or not, may be a subject for consideration in a posterior part of this article; the fact is undeniable.

In former times, the farming stock of the Highlands consisted principally of horned cattle, and these not only required more people to attend on them, but furnished the means of subsistence in greater variety than sheep. A few straggling goats also appeared there; and a very small number of sheep, of the small dun faced and fine woolled breed, now almost extinct. Large tracts of country were left by the great landholders, to be occupied mostly as forests for their deer. The chase furnished some degree of employment and subsistence; the cattle were conveyed in summer to the high grounds or heathings, in so far as these were accessible, and then brought down to the straths or vales on the approach of winter. From these were obtained considerable quantities of milk, butter, and cheese; and, though seldom well fed, there was a proportion of the cattle that became fat, and were slaughtered for use. A very severe winter and spring occasionally occurring, consumed the little stock of provender that could be raised in the country for such multitudes of cattle, and great numbers of them perished; while the surviving animals were so reduced, as to become of little value. The manner of so many beasts, however, enabled the people to cultivate many spots of land in all parts of the Highlands, and, one way or other, there were means found for supporting a considerable population. But under such a system, the Highland mountains were occupied by a stock not adapted for them, and of this kind of stock there were more than could be preserved during the severe months on the straths. In short, the country was at one time improperly stocked, and overstocked. It required many articles, the produce of other parts of the kingdom; but it raised by much too little to serve as articles of exchange by export.

The introduction of large flocks of sheep to stock the mountains of the Highlands was rather hazardous. Vast numbers of birds and beasts of prey existed there, and proved extremely destructive to them; and the native inhabitants were naturally jealous and hostile. By degrees, however, it became quite apparent, that sheep were the safe and proper stock of those mountainous regions. They could wander in safety where cattle could not go; they fed and threw where cattle could not have subsisted; and in winter they could feed on the coarse pastures, or dig through ordinary falls of snow, without requiring dried provender. But what turned out of most importance, in point of consequences, was this, that the produce of sheep flocks might be mostly exported, and commanded a regular and ample price in other parts of the kingdom.

All these particular co-operated in recommending preference in the systems of sheep husbandry; and the last circumstances appear to have been decisive. Landholders would not give up the advantages to be derived from such a profitable stock, and as the produce was destined mostly for exportation, many of the inhabitants were obliged to remove.

A very liberal increase of rents, was the invariable consequence of introducing sheep stocks: They were safer, they required much less attendance, and the returns were adapted to go regularly to the markets of the south of Scotland and of England at little expence. The numerous population could not then be supported, and their labour was not much wanted; emigration of course began, and went on.

It happened, that at this critical period uncommon encouragement was held out for new settlers to assist in peopling the wilds of America. Highlanders dispossessed of their farms, having no immediate view of employment in their own country, and not well adapted nor much inclined to engage in manual labours in other parts of the kingdom, were naturally attracted by the prospect of becoming, on easy terms, proprietors of better lands in the colonies. A portion of inclination, on account of their removal from lands which had long been occupied by their ancestors, naturally mingled in their feelings on such an occasion. Mutual understanding led them to courage and perseverance. They rose above those tender feelings of attachment to their native soil and country, for which they had been long distinguished; and they freighted vessels, and embarked for America.

The plastic genius and vigorous constitution of such Highland a people, rendered them uncommonly valuable settlers in a new country. They were equally fitted for labour and for mutual defence, and were therefore encouraged and courted to remove. The success of those who had first emigrated, likewise encouraged others to follow their example, as they also were in succession removed from their possessions, and flocks of sheep introduced. In a short time, land proprietors in the Highlands were reduced to the necessity of deciding between their feelings and their interest. If they yielded to the former, they devised such measures as they could for preserving their people; if they gave way to the latter, the people had scarcely a choice left them,—they were obliged to emigrate.

To describe the affecting scenes which occurred, alternative when a vessel charted for America arrived, and when lives of the several hundreds of these people were preparing to quit their proprietors for ever that land to which they were ardently attached, would be a painful task, and in the altered views and circumstances of those emigrants it is now unseemly. Many of their descendants in the New World, have long ago ceased to possess those warm attachments for the land of their fathers; but others residing in the British colonies, retain the noble spirit of their ancestors, and employ it with distinguished effect in their defence.

Accordingly the number of emigrant cargoes increased, it began...
EMISSION.

The emigrant bill, which passed in 1803, has a tendency rather to prevent imposition on the part of ship contractors, than to prevent emigration. The securing of ample space and provisions, removes the first and most formidable danger which emigrants had to dread. No doubt they must pay more liberally for so much better accommodation; but this difference is not so great, as to prevent any considerable number who had it at heart to embark. As a measure of policy, therefore, its influence cannot be great, but it must obviously have considerable effects as a measure of humanity. In one view, by discouraging artful and insidious contracts, it may operate in both characters.

A more powerful bar to the progress of emigration is presented at this time (1814), in the second American war. It is also to be expected, that the gradual diminution of the wilds of America must proportionally reduce the demand and encouragement held out for settlers; but this will depend on the arrangement of territory at the conclusion of the war, and on the further progress of the policy of colonizing.

The most pleasing means that can be employed for the purpose of preventing emigration must be devised at home; and this has not escaped the attention of a liberal and enlightened legislature.

A rugged and uncultivated country, destitute of proper means of communication, can hardly be expected to furnish means of subsistence for a growing population; and it cannot be supposed, that any country, in such a state, can afford to pay for such expensive works as canals and roads, capable of opening it up. The Highlands of Scotland were precisely in that state, when the great and liberal plan was formed, of opening a passage from fort George by fort Augustus to Fort William, by means of the Caledonian Canal. This great undertaking must necessarily require some years to complete it; and afterwards time will be required, in order to render it extensively useful. The important objects of this work, are likely to be greatly promoted by the invention and use of steam-boats employed on the lakes. In the mean time, a field of useful labour is opened within that country; and in the end, it cannot be doubted, that very great advantages will be derived from such a splendid national work.

In prosecution of the same general plan, the Highlands of Scotland have been intersected by roads in the most useful directions, executed under the authority of parliament, partly at the public expense, and partly at that of the landholders of the country: and provision is made also for keeping these roads in due repair. Thus there is laid a great and promising basis of public industry and improvement in that country; and if unforeseen events do not prevent the proper use of it, there can be little doubt, that such improvements as are suitable to the country will naturally follow; and these must have a powerful effect in preventing the necessity of such extensive emigration.

The navigation of the Caledonian canal is not only well defended by the chain of forts at the two extremities and the centre of it; but the lakes not being liable to freeze, there is an advantage not commonly to be obtained in canals, which may be expected from this property in its waters. Vessels of great burden, it is intended, shall have depth of water to convey them from the Murray Frith to the Linneleoch, and thence to the Sound of Mull and the Atlantic. A communication thus opened between the eastern and western seas, without going round by Cape Wrath, or encountering the dangerous passage of the Pentland Frith, must be

PUBLIC ATTENTION DRAWN TO IT, AND MEASURES DEVIRED FOR PREVENTING THE CRUEL ABUSES PRACTICED.
Emigration.

extremely useful to the commerce of the kingdom; and the transit of merchandise and vessels through the canal, must eventually tend to the improvement of the country.

Placing of forest trees on the great scale may now be accomplished with every prospect of a free market, and ample remuneration. This alone, over a country such as the mainland of the Highlands, may, in time, be an improvement more than sufficient to repay the great expense incurred by the public in opening it up. In the mean time, planting on a liberal scale will adorn and shelter the country, and may become a source of high attraction and elegant amusement for the landholders. A supply of timber in sufficient abundance in the country, and the use of water-borne coal, may naturally be expected to furnish means for introducing manufactures, especially that of wool, which is raised in great abundance in the Highlands.

Facility of conveyance of lime and farm-produce, must naturally suggest to the people of the country to open quarries, and burn the limestone that abounds in many districts; and there cannot be a doubt of a market, on a growing scale, for the returns.

Trade and population require supplies of fat cattle and sheep; and, of course, many would, in improving circumstances, be fattened within that remote district. This new demand would improve the general style of farming. Green crops and inclosures would be necessary on most farms; and these naturally associate with corn, and require the labours of an increasing population, furnishing also the means of their subsistence.

Growing interest and activity naturally discover new sources of employment for the people. The iron forges of the Highlands might be renewed on a greatly improved and enlarged scale; mines and minerals of different sorts might be worked to advantage; quarries of marble, blue slate, or useful stone, would probably be opened; and this country, so long threatened with desolation, might smile, and might be able to rear and support an augmented population.

Ignorance alone, or prejudice, can maintain, that sheep farming is inconsistent with such views in the Highlands. Even this legitimate system is imperfect and incomplete, without cultivation. Plantations to shelter the sheep stocks, (which they do admirably, and without being injured, when of sufficient age,) are necessary to the prospering of the improved breed of sheep; and no stock or breed of sheep can be brought to perfection, without the benefit of green crops to fatten, and of inclosures to separate them, and to enable the farmer to manage them to advantage. The best cultivated pastoral districts present such an arrangement; and they discover such a due proportion of black cattle as is necessary to secure the means of comfort and of improvement, together with the largest returns from the soil. The milk, hides, and tallow of these, afford comfortable means of employment and of subsistence; and a much greater number of people is maintained, than could have been supported under an exclusive sheep system. Woods, cattle, and the mixed culture of hemp and flax, naturally present extending advantages in prosecuting the fisheries, and in attending to various useful manufactures, besides promoting the comfort of the inhabitants, and co-operating with the other modes of improvement in preventing emigration.

The Highlands, thus opened up and improved, would furnish useful employment and ample subsistence for a much greater number of inhabitants than they have ever yet contained. It is true, that the remarks made above apply chiefly to the mainland, and that other views would be necessary in respect of the northern and western isles.

If the mere crofting system were all the resource that is now accessible to the Highlanders, it could not much be depended on. There is a considerable waste of time and labour in it, and the means and skill employed in this way are commonly deficient. No doubt, it may in some degree be useful, particularly if the crofters can also find occasional employment as labourers to the farmers; but an altered and improved system of farming appears to open the great resource on the mainland. The rise of a competent number of inclosures, and a proper stock of cattle, together with calcareous manures and green crops, and corn of course, properly selected, and cultivated with judgment, would not only furnish employment and subsistence, but would greatly increase the produce and value of those extensive tracts which are capable of improvement; and the consequence would be, that the country at large would be converted from a sheep-waste into a fertile alpine territory. It would then be in the power of landholders, at a moderate expense, to clothe it with rich and ornamental plantations; and afterwards that country would present many inducements and attractions to reside in it; and manufactures, together with the fisheries, would more certainly be supported. In short, there would no longer be any occasion for the people to emigrate in bodies from the mainland of the Highlands.

With respect to the isles, they already possess two State of the considerable sources of employment—the fisheries and the manufacture of kelp; but these isles are generally naked, without fences, and, of course, almost in the state of mere wastes, excepting only the lands in tillage; and these are incapable of improved cultivation while they are open every winter. The making of kelp, and attention requisite to the fishing business, being commonly in the hands of those who labour the soil, correct and regular cultivation is obstructed, and scarcely practicable. There appears to be no remedy for this, until a regular system of inclosures be introduced; and then it is no exaggerated supposition, that the sheep stocks may become triply valuable, and the cultivated soils greatly more productive. After this plan has been adopted, the regular tillage of the arable will naturally become the creed; and the increased value of proprietors will accompany inclosures, the labour will divide itself into the proper seasons, and fewer hands, regularly employed, will perform it. What encroachments may then be made on the waste lands cannot be computed; but they will naturally be of considerable importance and extent. Islands possessing a great extent of low situated lands, numerous herds of black cattle, and calcareous manures in many parts of the land or the shores, together with seas-weed, are subjects adapted by nature for improvement; and the climate is not very unfriendly to early corn, while it suits admirably for turnips, potatoes, and grass with seeds. On the larger islands, and on some of the smaller, stone may be obtained for exterior fences, and sometimes also for subdivisions; and on these isles where stone cannot be got, ditches well designed, and properly executed and preserved in repair, with such hedges as may best answer according to circumstances, may operate at once as fence, drain, and shelter.

This general and improved system is no speculation. It is already introduced with great advantage by some of the most intelligent and public spirited proprietors.

Artificial manures would be encouraged.

An improving style of agriculture would follow.

Quarries and mines.

These advantages and improvements naturally associate with each other in other districts of the kingdom.
of estates in these isles; and it proves an increasing source of employment and subsistence for the people. Judicious planting of suitable parts naturally accompanies a system of this kind; and, by selecting proper situations, planting the slips with suitable trees, and then putting in seedling trees in large bodies, there is much less risk of their failing by the breeze. No person acquainted with the country can hesitate in believing that profitable employment, and growing means of support, would thus be furnished, for all the present inhabitants of the isles; although they should not be occupied with kelp at all, or with fishing. The great object is to get them trained to labour so as to perform it well, and with dispatch; and after this, it will be in the power of landholders to arrange the leases of their lands, with views of regular and progressive improvements.

Kelp-making and fishing now connected with crofting.

A growing population, in the mean time, can furnish hands for the kelp-making and the fishings; and these are, perhaps, the people that ought to be accommodated for the present with croft lands. In time it may become expedient to separate these professions, finding other occupation for the people employed in these departments, when they are not engaged in them. Such a resource may be naturally obtained within the country in jobs or piece work,—if they are trained to make use of their spare time, in building dykes, cutting drains or ditches, planting trees, quarrying stone or slate, making roads, paring and burning waste lands, preparing composts for meadows and other purposes. The opening of the country by roads and canals may further introduce the manufacture of wool, or flax, or hemp, and other useful branches of the arts; and even in the low and smaller isles, ample occupation may be found for the inhabitants.

Such a system would impede emigration, and in due time bring it to an end.

Consequences of emigration in many ways hurtful.

Discourages inhabitants, and prolongs the deplorable state of the country.

Removes a supply of men for the army and navy.

Counteracts the purposes of public works.

Impedes the progress of the fisheries.

Consigns the Highlands to a sheep waste.

Happy effects of a general and rational system of improvement,

In promoting the interest of all classes.

In causing emigration to cease.

SHEEP WASTE. Even timber for dwelling-houses, and materials to build them, could hardly be expected in a remote and rugged country, drained of most of its people. With opposite views, the subject of emigration has been treated with considerable ability by various writers; but the real history of emigration, its causes and effects, and above all, its prevention, have scarcely been understood. Interested or partial views of a subject are well known to mislead authors of eminent talents; and a person of narrow conceptions, who could view only the present state of the Highlands, might be surprised into the opinion that the country cannot support a growing population. But if our views be extended to what the state of this country may and ought to be, we must resist and at once dismiss that idea. Views of improvement may be cherished even by a landholder, which are not sufficiently liberal towards the people at large; but the true plan of occupation and improvement in that country must embrace enclosures; and then it may become the basis of a system, equally judicious and profitable to all concerned.

Even the prospect of such a system, as would steadily and progressively add to the resources of that remote but interesting part of the British territory, is pleasing to the mind. It would certainly increase the value of the lands, and add materially to the comfort of the inhabitants. Opened by means of the great canal and the numerous roads intersecting the country, together with its various and extensive seas, and their indenting arms; enjoying the benefit of well planned and executed fences, at once inclosing, draining, and sheltering the numerous fields capable of being gained from extensive wastes; adorned with rising plantations of forest trees, and accommodated with the timber and the shelter they would afford; possessing well cultivated fields, enriched by the manures which abound in the country, and productive in early grain, and green crops; having improved stocks of the valuable breed of Highland cattle, together with sheep of superior quality, to the maintenance of which an improved system would be adequate; and possessing a population growing at once in point of numbers, industry, and comfort, equal not only to the labours of husbandry, but also to the fishings and various useful branches of manufacture; while commerce opened the way, and gradually furnished the means to acquire wealth; with all these growing advantages in their favour, the Highlands and isles of Scotland would possess many attractions; and the last and melancholy resort of a people driven to despondency, emigration, would cease.

(E.K.)

EMISSION OF HEAT. See Heat.

EMISSION OF LIGHT. See Optics.

EMOY. See China.

EMPEDECLES, was the son of Meto, a wealthy citizen of Agrigentum in Sicily, and flourished about the 84th Olympiad, or 440 years before Christ. It is not probable that he was born at so early a period, as to have been a hearer of Pythagoras; but he adopted the doctrines of that philosopher, and appear evident, from his own tenets, to have belonged to the Ionic school. He was remarkable for the variety and extent of his attainments; and his name became so celebrated, that when he went to the Olympic games, the eyes of all the people were fixed upon him as one of the wonders of the age. He excelled in oratory, upon which he was the first who gave lessons in Sicily; and the celebrated Gorgias Leontinus was one of his pupils.
Empedocles. He was possessed of considerable poetical talents, and has been supposed to be the author of that ancient fragment, which bears the name of "The Golden Verses of Pythagoras." The fragments of his verses, dispersed through various ancient writers, have been collected by Henry Stephens in his "Poetry of the Philosophers;" but, if credit may be given to the high commendations bestowed by Aristotle, Lucretius, and others, upon his poetry and eloquence, the greater part of his productions in both these departments must have perished at an early date. He was not less distinguished by his skill in medicine, and seems to have owed much of his influence and reputation to the wonderful cures which he was understood to have performed. These he did not hesitate to pass upon the multitude as the effect of magic, or of some miraculous power; and pretended not only to cure all diseases, but to drive away old age, and to restore the dead to life, to raise or moderate the winds, to produce rain or heat, and to check the progress of epidemic diseases. He may be supposed, indeed, by his medical and physical knowledge, to have rendered several actual services to his country, as when he is said to have removed an enemy by fumigation, and thrown a chasm in a neighbouring mountain, from which he observed pestilential effluvia to proceed, and another by correcting the corrupted waters of the river Seleus, by directing two small streams into its channel; but he appears to have taken advantage of the ignorant admiration which he received, and is reported to have been highly gratified with the divine honours which were paid him on some of these occasions. He made a liberal use of his large paternal estate, especially in giving dowries to young women, and procuring them suitable marriages. He took an active interest in the political state of his native city, and was a determined enemy to tyrannical measures, and a zealous advocate for the popular form of government. He at length became an object of so great veneration to his fellow citizens, that they were ready to acknowledge him as exalted above the nature of man, and finally offered to invest him with the sovereign power. Preferring the simplicity of private eminence to the dispensations of public life, he declined to accept the office and title, while, at the same time, he evinced a strong disposition to assume all the distinctions and appearance of royalty. Clothed in a purple robe, crowned with laurel, with brazen sandals on his feet, with long flowing hair, with a grave and commanding aspect, habitad, in short, like the gods, and accompanied by a number of attendants, he was fond of parading the public ways, and receiving the plaudits of the people. He is said by Aristotle to have died at sixty years of age; but very various accounts are given of the manner of his death. Some authors relate, that he broke his leg by falling from a chariot, which brought on a mortal distemper. Others say, that he terminated his own existence by throwing himself into the sea, or by strangulation with a rope. Another account affirms, that, in his anxiety to examine the crater of Mount Etna, he advanced too far, and accidentally fell into the burning gulf. While another report bears, that, after a sacred festival, he ascended Mount Etna during the night, and threw himself into the volcano, in the hope that, the manner of his death being unknown, he might afterwards be accounted a divine person; but that one of his brazen sandals having been thrown out in a subsequent eruption, his mortality was sufficiently confirmed.

But the most probable opinion is, that, as Timaeus relates, he went to Greece about the latter part of his life, and never returned to his native country, so that the time and manner of his death was never certainly known. A statue was erected to his memory at Agrigentum, which was afterwards carried to Rome; and the inhabitants of that city, even in the time of Lucretius, made it their highest boast, that it had given birth to so eminent a person as Empedocles, whose poems particularly they still regarded as oracles. Of the few of his sayings which have been preserved, the most frequently cited is his reproof of the luxurious manners of the Agrigentines, namely, that "they pursued pleasures with as much eagerness as if they were to die before to-morrow, and that they built houses with as much magnificence as if they were to live for ever." His philosophy, as far as it can be collected from his fragments, is evidently rational; that the first principles of nature are of two kinds, active and passive; that the active is unity or God, a subtle ethereal fire, intelligible and divine, which gives being to all things, animates all things, and into which all things shall be finally resolved; that one spirit thus pervades the universe, uniting all created beings to itself and to one another, and that it is therefore unlawful to kill or eat animals, which are allied to us in their principle of life; that the passive principle, viz. matter, is divided into round corpuscles, indefinitely small, originally eternal, and never capable of being annihilated; that these corpuscles, being put into motion by the intellectual fire or divine mind, the homogeneous particles united by a principle of affinity, and the heterogeneous separated by a principle of discord, and thus formed the four elements, fire, earth, water, and air, of which all bodies are composed; that the world is one whole, surrounded by the heavens, which are a solid body of air crystallized by fire, the sun a fiery mass, the stars fixed in the crystal of heaven, while the planets wander freely beneath; that many demons, emanating from the divine nature, inhabit the region of the air, and administer human affairs; that the soul of man consists of two parts, the sensitive, produced like the elements, and the rational, a demon sprung from the divine soul of the universe, and sent down into this world as a punishment for crimes committed in a former state, to be purified by transmigrations through animal and vegetable bodies; that he distinctly remembered himself to have been successively a girl, a boy, a bird, a fish, a shrub, and, lastly, Empedocles; and that all nature is subject to the immutable and eternal law of necessity. See Cudworth's "Intel. System;" Stanley's "Lives of the Philosophers;" Fenelon's "Lives of the Philosophers" translated by the Rev. J. Cormack; Castellani's "Phil. Medic. Hist.;" and Brucker's "Hist. Phil." by Enfield, vol. i. (q).

EMPETERUM, a genus of plants of the class Diccia, and order Triandria. See Botany, p. 335.

EMPLEUNON, a genus of plants of the class Monocotyledons, and order Tetradria. See Botany, p. 324.

ENAMEL is a substance of the nature of glass, but differs from it principally in two points: first, in being more easily fusible, which quality is given to it by the manner in which the flux is compounded; secondly, in having a large proportion of either earth, or metallic oxide, united with the flux, to produce opacity. Some enamels are, however, very transparent, possessing...
The best enamel that can be had for the purpose of making large plates for painting pictures upon, is the Venetian white opaque, with the name of Bertolini stamped upon the cakes, which cakes in general weigh about two pounds each. This article has not been imported for some years past, owing to the exclusion of the British trader from the continent. The writer of this article has, however, been informed, that the maker of the best white enamel, whose name we have just mentioned, fell a sacrifice to French tyranny during their struggle for power in Italy and Naples. That this valuable article was the sole production of an individual, the manufacture of which was unknown to any but himself, may be inferred from the non-importation since the change of government in Italy, although every exertion has been used by those interested in the use of it, to obtain it at any price.

When enamel could be brought to England without restriction, it was generally sold for about six shillings per pound; but as it grew scarce, 30 shillings per pound was given, and, at the present time, it is as high as fifty shillings. This high price proved a great stimulus to those, who knew anything about the nature of its ingredients, to exert themselves in their endeavours to find a substitute, and numerous were the trials of various persons to make an imitation. All attempts, however, were ineffectual, until, very lately, when Mr Griffiths, of Round Court, Long Acre, London, succeeded in producing a hard enamel, superior to the best Venetian in whiteness, and much more valuable to the dial-plate makers. But the Venetian is still preferred for fused plates, used for portrait and historical paintings; and, as these plates have always a coat of pure flux laid over the enamel, upon which the colours are laid, it requires a peculiar texture in the enamel, so that when the flux is melted upon it, a partial separation or cracking should not take place, which arises from the unequal expansion of the two substances. We have no doubt that the colouring material used with the flux to produce the white Venetian enamel, is the pure oxide of tin, commonly called putty. The manufacturers of putty in London, are in the habit of using 30 per cent. of lead mixed with the tin, which assists the oxidation, causing it to proceed much faster than when the tin is used alone; but the article made in this manner has a considerable tinge of yellow, which renders it useless for the purpose of enamel, although it may suit the lapidary or stone mason equally well as if it was made pure. (r.e.)

ENAMELLING, the art of covering thin plates of metal with the substance called enamel. As this curious art is carried on to a considerable extent among the manufacturers of watch dial plates, we shall give our readers a general idea of the art of enamelling, by explaining the nature of their manufacture.

**Dial Plate Manufacturing.**

Dial plate making is divided into hard enamelling, in which the surface of the plate is covered with hard or Venetian enamel; and into glass or soft enamelling, in which the surface of the plate is covered with the English soft glass enamel, which is always considered much inferior to hard enamelling.

The metals that suit this kind of enamelling best, are fine gold or fine copper; the former may be had from Enamelling any goldsmith, the latter at the flatting mills, known by the name of enamellers copper. It is necessary to caution persons unacquainted with the art against using the copper too thick, as, in that case, the plates would crack in the fire.

The slips of copper being cut into square pieces, put them into a clear fire, till they have attained a red heat; when cold they are forced into the intended shape of the dial. Before proceeding, however, to explain this process, we shall here introduce a description of the tools required in the operation.

1st. The dies are small circular plates of brass, about ¼ th of an inch thick. Their edges should be turned a little conical, and in their centres should be holes nearly as large as those to be made in the dial plates. An enameller ought to have at least forty of these, from 3ths of an inch, up to ½ inches diameter, observing that the gradation from one size to another should be exceedingly small, having three sizes between every division on the gauge. See Fig. 1. of Plate CCLII.

2d. A round ended punch made of steel wire, about ¼ ths of an inch thick and ¼ long. This should be fixed in a convenient handle, and is then fitted to punch up the copper into the centre holes of the dies. See Fig. 2.

3d. A clock maker's round broach. This should be firmly fixed into a strong handle, being used to burrish up an edge to the copper, and likewise to square up the centre holes. See Fig. 3.

4th. A die or block, to set the copper of the desired concavity. This should be turned of box or any other hard wood, and should be a little larger in its diameter than the largest brass die. This must have a hole through the centre something wider than the hole in the dial plate. See Fig. 4.

5th. A large pair of scissors to cut the copper with. Horse scissors are most proper for this purpose.

6th. A setting spatula, which should be made of steel wire, about ¼ ths of an inch in diameter and 5 inches long. One end of this should be bent flat and thin. The end so prepared is then to be filed a little round, and the flat part bent so as to form a segment of a circle, somewhat smaller than the curve of the setting die. The outer part of the curve should then be smoothed on an oil stone, and the tool is fit to be used. See Fig. 5.

7th. A smooth needle maker's file, used for filing the plated wire, which will be hereafter explained, and likewise the edge of the copper, after it has been burnished up to the edge of the brass die.

8th. A small steel point, which should be rather stouter than a stocking needle, used for marking the place where the feet of the dial should be put, and other purposes to be described. See Fig. 6.

9th. A large soldering lamp, which should hold at least a quart of oil. This must have a cylindrical spout for the cotton, at least one inch and a quarter in diameter, that the oil may have free access to the lighted end of the cotton. See Fig. 7.

10th. A pair of corn tongs, or tweezers. These are so well known as to need no description.

11th. A blow pipe for soldering the feet upon the copper, of a convenient length, and the hole a little more open than for other purposes.

12th. A watchmaker's glass and dial gauge. See Fig. 8.

13th. A pair of nippers to cut the feet from the plated wire.

The tools being ready, the workman should proceed
to measure the frames of the watches; and supposing that he finds the frame to correspond with one of the divisions on the gauge, he should choose a die half a size larger, as the dial must always be one size larger than the frame, which will be the case when the thickness of the copper is included. It will be found, if all is conducted according to our directions, that the dial, when completed, will extend over the frame just enough to fill the groove in the inner case of a watch, which will be turned for that purpose. If the dial is to be made to a brass edge, the die should be full one size less than the inner rim; for as the dial has to lie within the rim of the edge, an allowance must be made for the thickness of the copper, and likewise for the swelling of the plate in the fire, which is a circumstance that invariably happens. The proper die being chosen, place one of the pieces of copper on that side of the die which has the smallest diameter, and as nearly in the centre as possible; lay the die, with the copper upon it, flat on a table or board, and the round ended punch, Fig. 2, being put on the centre, press it down and wriggled round till the end of it is forced as far as it can go into the centre hole of the die. The copper is then to be taken off, and the bulge thus formed must be filed nearly through. Let the copper then be placed on the die in the same manner as before, and the round broach gently thrust through the centre hole, till it fits it nearly tight to the die. When this is done, holding the die and copper in the left hand, with the die upwards, let the copper be cut as nearly round as possible, leaving it about \( \frac{1}{2} \) th of an inch larger than the smallest side of the die. This may be best accomplished by holding the scissors a little aslant, till the desired breadth is obtained. The die, with the copper uppermost, is then to be laid on the work board, and gently rubbed or burnished over with the round broach, till the copper lies quite smooth and flat on the die. Hold the die and the copper firmly in the left hand, and having the broach in the right, burnish that part of the copper which extends beyond the edge of the die, which is best done by rubbing the broach round the copper, and pressing it close to the edge of the die. The copper is now to be taken off the die, and the edge or rim thus formed must be finished by filing it till it is equal on every side. The centre hole must be filed a little to take off the ragged parts, but it must not be made so low as the edge; and the bur that is formed by filing should be scraped off with the edge of a graver. The copper is then set up to the desired convexity, by placing it in the setting die, and rubbing it with the setting spatula till the copper touches in all parts; after which the feet is soldered on.

The inconveniences that attended the use of plain copper wire soldered with spelter for the feet, are now entirely obviated, by employing copper wire plated with silver. When the copper is set up properly, place it exactly on the frame of the watch. Hold the copper and frame in the left hand, and with the point or needle mark through the holes in the frame where the feet should be placed; then place the copper in the setting die, and describe small squares, about each of the marks that have been made with the point, observing that these must be large enough to admit the foot wire to be placed within, as the intention of the squares is nothing more than to throw up a bur or ridge, to prevent the foot from slipping out of its place during the operation of soldering. The feet for the copper must now be cut, by fixing an iron peg into the work board, and the pieces of plated wire being held against it, it will be found to form a very good resistance to the action of the file. It should be observed, that if coppers are to be made for flat plates, the feet should be filed at right angles; but if the plates are convex, they should be filed at an angle as nearly as possible corresponding with the curve formed in the hollow part of the copper, because when the foot is placed on the copper, it will be found to stand perpendicular to the base line, or edge of the copper. The feet thus filed should be cut off with the nippers; if for frame plates, about three-sixteenths of an inch long; but if for flat plates, one-eighth will be sufficient. A small quantity of borax should now be rubbed upon a piece of slate, with the addition of a few drops of water, into which the filed parts of the feet being slightly dipped, will greatly facilitate the soldering. The copper is then to be held in the left hand, and the feet taken up with the tweezers are to be set in their proper places on the copper, when it will be fit for soldering. When a great number are to be done at once, it will be the best way to hold up all the feet before any are soldered. In this case, the frames set on the board with the pillars upwards, make very convenient stands to place the coppers on till they are soldered. It must be carefully observed in this kind of soldering, to use the borax very sparingly; for as it blisters up when the heat first comes to it, the feet would be thrown down, which would occasion much difficulty and loss of time in replacing them.

Take now a large piece of charcoal of a close texture, and hollowed out, so that the copper may lie conveniently in it, and having your lamp near the edge of the board, and the copper placed on the coal, which should be held in the left hand, put the end of the blowpipe into the centre of the flame, and holding the copper nearly under it, give a very slight but steady blast till the copper is red hot. The pipe should now be withdrawn from the centre, that the whole of the flame may be collected, which will be done if the operator blows as hard as he can. When the copper is arrived nearly to a white heat, the centre of the blast must be placed immediately over each of the feet till the solder runs down to the copper, and the soldering is complete. If the feet have kept in their places, they will fit into the holes of the frames; but if they have shifted a little, which will frequently be the case, fit them into the frame, by placing the copper in the setting die with the feet upwards, and the frame being held over the feet, bend them whichever way may be requisite, by introducing the setting spatula between the frame and the copper, pressing it against that side of the foot or feet that may be necessary, till they fit into the holes of the frame. When this is done, the copper is to be gently withdrawn from the frame; and if, upon examining the upper side, any dints or bulges have been made, they must be taken out by putting the copper into the setting die, and rubbing the spatula round the feet till such imperfections are removed. When a copper is made to a brass edge and frame for a second watch, the second, or eccentric hole, must be made in the following manner, after the copper has been soldered and set. Place the copper in the brass edge and frame, holding the copper downwards on the board, with a fine needle or point put perpendicularly through the seconds hole of the frame; prick quite through the copper a very small hole, which must be bulged or raised, by having a corresponding hole drilled in one of,
the dies. The copper is then to be placed on the die, and the hole that has been prickled, must be placed exactly over the hole that has been drilled in the die. A smaller round-ended punch should be used to bulge up the hole, which is to be done in the same manner as was directed for making the holes in the centres of the plain coppers. The hole must be finished by filing the upper side; and if upon examination it does not correspond with the hole in the frame, it must be made to fit by placing it on the die again, and opening the hole with the point, bearing most on that side that is most out of the centre. It should be observed, that although the plate for a seconds watch is desired to be as flat as possible, yet the copper should be set a little rising; for if it was not kept up a little in the centre, when the enamel is put on and the plate fired, it would sink in the centre, an imperfection for which there is no remedy. We would recommend, that all copper used for flat plates should be annealed and planished before they are put to the die. This may be done on a piece of flat marble; and the hammer should be made of elder, or hard boxwood, having a very smooth face. The use of this operation is to take away the cockling kind of spring, that is always left in the copper when it comes from the flattening mills. To perform this nicely, requires much judgment in the operator; for if the copper is promiscuously struck with the hammer, it is ten to one but the imperfection is increased; therefore to proceed rightly, the copper must be examined, and that part which is found to be the tightest, or least stretched, and upon which the other parts will appear to twist and play, must be hammered till an uniform flatness is obtained. The best method of ascertaining when the spring is gone, is to let the piece of copper fall from a small distance upon the marble slab, and if there is no vibration or ringing noise, we may conclude that the operation has succeeded. We should not have been so particular on this point, had we not been convinced of its utility; for if this is not done, the metal will expand unequally in the fire, which will certainly cause the enamel to crack in the fire, or warp in such a manner as to be wholly useless. We must not omit the method of cleansing, (or picking the copper as it is technically called,) it being necessary in all cases where great nicety is required. This is done, by making a solution of the best double aquafortis and water, about one part of the former to eight of the latter. Put the coppers, as soon as they are all soldered, into as much of the solution as will cover them, and when they have remained two or three minutes, let one of them be taken out and washed in clean water, and brushed with a soft brush and a little white sand. If the scale comes all of, and the copper looks quite bright, they are sufficiently done; if not, let them remain sometime longer in the solution, and, when brushed as before, dry them with a soft napkin.

**Description of the Tools used in Enamelling.**

The first is an agate pestle and mortar to grind the enamel. The best kind are those that are most transparent, and free from opaque spots and veins. See a section of this in Plate CCLII. Figs. 9, 10.

The second is a small hammer about an ounce and a half in weight. One face should be flat, and the other of the shape commonly used in riveting.

The third is a flat spatula seven-eighths of an inch broad, and a little thicker than those used for paint knives.

The fourth is a spatula rather thicker than the last, but of equal breadth. One side of this should be flat, and the other a little curved. This must be made of good steel, and is used to spread the hard enamel on the copper. See Plate CCLII. Fig. 11.

The fifth is the spatula, for spreading the hard enamel on the under side of the copper. This is called a bottom spatula. The end of this should be just the same as the end of the setting spatula described in the copper tools, excepting that it should be a little broader.

The sixth is a quill cut just like a tooth-pick. This is used to clear the enamel out of the centre holes of the coppers.

The seventh are two damask napkins, for drying the water from the enamel. These should be very clean, and always kept separate.

The eighth is a small basin with a cover, to hold the enamel that is to be used for the tops of the dial plates.

The ninth is a gallipot, to hold the enamel that is to be used for the bottoms, or under side of the dials.

The tenth is a cylindrical block of wood, to fix the copper on when it is ready to have the enamel laid on the top. This for common sized plates, may be about an inch and half diameter, and about six inches long. On one end of this some soft wax must be fixed, so that it may form a kind of cap to the block, being about one-third of an inch thick on the top, and the same on the sides. See Fig. 12.

The eleventh is a box to hold the plates in, when the enamel is spread on them. This may be about 16 inches long, and 9 broad. The depth may be one inch and a half; but it must not have any side under the opening of the lid.

The twelfth is a small steel-faced anvil to hold in the hand, to break the enamel into small pieces. The face may be about one inch diameter, the other part in proportion.

**Method of grinding the Soft Glass Enamel, called by Enamellers Glass.**

Take a cake of glass enamel, and with the riveting face of the hammer strike it as near the edge as possible, holding, at the same time, the forefinger of the left hand just under the place where the blow falls. By this means, the vibration that would be given to the whole cake will be prevented, and it will be broken into thin flakes. When thick solid pieces happen to fall off, the anvil must be held in the left hand, with the face upwards; and the piece being laid on it, must be broken with the flat face of the hammer, till it is small enough to be ground. To prevent the enamel from flying about, the anvil should be so held in the hand, that part of the fore finger and thumb may form a kind of rim.

The centre is generally the foulest part of the cake, and is often intermixed with black and red streaks. When this is the case, the coloured parts should be rejected, as they would otherwise contaminate the whole enamel. When the enamel is broken as small as is necessary, no piece being left larger or thicker than a small pebble, the agate mortar must be set on a piece of coarse linen cloth four times doubled, and made thoroughly wet with clean water. This should be laid on the work-board, and the mortar about half filled with enamel, which should be nearly covered with
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Clean water. The pestle is then to be wiped perfectly clean, and, being grasped by the middle with the left hand, the right hand placed on the top, and pressing against the right breast, the operator thus leaning over the mortar, must give a kind of twisting motion to the pestle, by bringing the right elbow round the pestle, forming the axis of the circle; while the body, being permitted to rise a little after each twist, fresh particles of the enamel will fall under the pestle, and be completely crushed. This part of the operation should be continued as long as any large pieces of the enamel are felt under the pestle; for it should be observed, that if this great pressure, or breaking down, as it is technically called, is pursued beyond the proper time, some parts of the glass would be reduced to almost an impalpable powder, while the other part would remain comparatively coarse. To prevent this unevenness, the pestle should be held firmly down in the mortar, with the left hand grasping it as before, while the right hand gives a circular motion to the upper part, at the same time using as much strength as can be conveniently exerted. In a very short time after this method is begun, the large pieces that have escaped the pestle in breaking down, will present themselves under the pestle, and cause it to jump and twist in contrary directions. This may be prevented, by feeling for them with the pestle, and crushing them against the side of the mortar, holding it at the same time firmly with the left hand. As the fine flour, into which some parts of the enamel is ground, would prevent the rest from being evenly ground, it must be washed away four or five times during the grinding. This is best done by nearly filling the mortar with clean water, and agitating the enamel with the broad flat spatula, stirring it from the bottom till the water appears quite milky; the enamel should then be suffered to settle to the bottom, and the water poured off. A small quantity of water must then be put into the mortar, sufficient to keep the enamel from clinging to the sides of the pestle, and the grinding continued till there appears a difficulty of getting the pestle to touch the bottom of the mortar. When it is arrived at this state of fineness, the pestle must be held in the middle with the right hand, giving it a circular motion, clearing the enamel from the sides of the mortar at each revolution. When this kind of motion is begun, it will be necessary to hold the mortar with the left hand, taking great care not to throw the enamel over the sides, because the dirt that it would contract by such an accident could not be got rid of without an infinite deal of trouble. Besides the risk of breaking the work in getting the specks from the surface of the dial plates, when the enamel has been fired. As it would be almost impossible to lay down a certain rule for the fineness to which the glass enamel should be ground, as different parcels, or pots, (as they are called at the glasshouse,) require to be varied, we can only say, that the finest should never exceed fine grain gunpowder, while the coarsest must never be left larger than made-seed. When the enamel is completely ground, wash the flour thoroughly from it, and put it in the basin, then keep it covered with water till it is wanted for use, taking great care that it receive no dust or dirt.

Method of grinding the Venetian hard enamel for the bottoms or under sides of the dials.

This method is to be broken with the hammer in the same manner as the glass enamel; but, instead of breaking it down in the agate mortar, it should be done in one made of iron, of a cylindrical form. The bottom of the mortar should be faced with steel, possessing a small degree of concavity, that the enamel may return to the centre after each blow. The pestle should be about one inch and a fourth in diameter, and about six inches long, with the face of steel, about one inch and a half in diameter, and a little convex, to suit the mortar. The depth of the mortar should be about four inches; and with respect to thickness, as there will be no strain upon the sides, the lighter it is made the better. It should also be observed, that the arris of the face of the pestle should be rounded, so as to leave no sharp edges near the part where it comes in contact with the enamel, as they would be soon broken off, and spoil the other part of the face. After the enamel has been broken with the hammer, it must be put into the steel mortar in small quantities, and pounded till it is as fine as the glass enamel, (when it has been broken down in the agate mortar; it should then be put into the agate mortar, and ground till it appears to be reduced almost to an impalpable powder. It must be remembered not to wash the enamel that is to be used for bottoms, as the flour will, in this case, be more serviceable than detrimental. When this enamel is ground, put it into a clean gallipot, and always keep it covered with water; for observe, if ever it gets dry after it is ground, it will be necessary to give it two or three turns in the agate mortar, otherwise the enamel is likely to blister in the fire.

Method of grinding and pickling the Venetian hard enamel that is to be used for the tops of dial plates.

When a piece of enamel is chosen for hard plates, great attention should be paid to the colour, that which is the whitest being considered the most valuable. The piece that is to be ground must be laid upon a clean planch (or, what would be much better, a thin plate of platinum), and placed under the enameller's muff if it is red hot; it must then be quickly drawn from the fire, and quenched in very clean spring water. This will cause the enamel to fly into very small pieces, which must be collected and put into the agate mortar. The intention of breaking the enamel in this way, is to do away, as much as possible, the necessity of using the hammer and steel pestle; because, if any small particle of the steel gets into the enamel, it will cause much trouble to get it out. The method of grinding it is just the same as that employed for the other hard enamel, excepting that this must be rather coarser; and great care must be taken, when the enamel is washed, not to throw away the water which contains the flour, which may be collected after it has settled, and put into the gallipot with that which is to be used for bottoms. When the enamel is ground fine enough, it must be put into a wide-mouthed glass bottle with a glass stopple, and covered with strong nitrous acid; and in this state it should remain till wanted for use.

Method of enamelling with the Soft Glass Enamel.

The napkin that is to be used for laying or spreading the bottoms, must be laid on the work-board four times doubled. The copper is to be held in the left hand, with the feet upwards, and a small quantity of the hard enamel for bottoms is to be taken out of the gallipot on the end of the bottom spatula, and spread roughly on the copper, covering it closely up to the feet and centre holes. It must then be laid between the folds of the cloth till a little of the water is absorbed,
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when it must be smoothly spread with the convex side of the spatula. If too much of the water is not absorbed, it will be found that the enamel may be very easily removed from the parts where it lies thickest to those that are too thin, till a general evenness is produced. It must then be smoothly spread, by drying it more with the napkin, and spreading it again with the spatula, observing always to bear proportionally lighter as the enamel gets drier. The centre hole must be cleared out by twisting the quill in it till it brings out all the enamel that is in it, and the operation of laying the bottom is complete.

A clean napkin is then to be folded in the same manner as for laying the bottoms; but it must be laid on the board so as to hang over the edge about three or four inches; and, to prevent its falling, it is best to put some kind of weight upon it. When the wax upon the last block has been softened, and made of a shape fit to receive the copper, it must be placed evenly on, and the feet pressed into the wax, till the under side of the copper nearly touch. This will be best done by placing the setting die on the copper, and pressing it down, as, by this method, the shape of the copper will be preserved, and the upper side secured from the perspiration of the hands, which might prove injurious to the work, as any thing of a greasy nature is very apt to make the enamel blister. The copper must now be brushed quite clean with a soft hair brush, or hare's foot, taking great care not to leave any of the hard enamel on the surface, or about the edge. The block with the copper on it is now to be held in the left hand, and a small quantity of the glass enamel is to be taken upon the end of the flat spatula, and laid upon the copper, near the centre hole, taking very great care not to let the water through the centre hole; as that would take the enamel from the bottom, which could not be replaced without taking the glass from the top, an operation that would be exceedingly dangerous, as the two kinds of enamel would get mixed together, which would inevitably spoil them both. If a careful attention is paid to what we have said, an evil of this kind need not be feared, as the enamel need not be taken out of the basin with so much water as to render it at all hazardous, if it is lifted slowly, and by that means suffered to drain a little. When a sufficient quantity of the glass enamel has been put upon the copper, it must be roughly spread, by repeatedly indenting the edge of the flat spatula into the enamel, crossing it in all directions till it lies of an uniform thickness all over the copper. The surface, in this state, will have various little inequalities and indentations, which may be reduced by just tapping the side of the block two or three times with the edge of the spatula. The water which this operation will cause to flow on the surface of the enamel, must be dried a little with the corner of the cloth, but not so much as to render the enamel difficult to be moved; for the intention of putting it in this state is to take away the superfluous water that floats on the surface. If, however, the napkin should at any time absorb so much of the water that the enamel could not be moved without such a degree of pressure as would lessen the feet of the copper from the wax, or risk bending the copper, a drop or two of water may be taken upon the end of the spatula, and applied to different parts of the enamel, till the desired effect is obtained. It rarely happens that the enamel, in this state, is so evenly laid as to want no adjusting; it must therefore be carefully observed, that the side or part which is too thick, must be reduced; by removing a part to places that appear deficient. This may be done by Enamelling spreading the spatula over the enamel, turning the block round with the fingers and thumb of the left hand, till it lies generally even. It must then be dried again with the napkin, and the surface made smoother, by passing the spatula over it in all directions, bearing a little harder on the enamel as it gets drier. As the rubbing and spreading the enamel in this manner will attract the moisture to the surface, and hinder the enamel from laying so smooth as is necessary, it must therefore be dried again, and the laying finished by gently passing the spatula lightly over the surface till the enamel lie very smooth and even.

In determining the thickness of the enamel, an allowance must be made for its granulated state previous to melting, when it occupies a larger space than it does subsequently. The enamel should therefore be spread a little thicker than the depth of the edge and centre would seem to require. In all cases, however, it will be better to have the enamel a little below the edge and centre when it is melted in its first fire, for reasons which we shall afterwards explain. One thing is to be particularly observed in enamelling the tops of convex plates, that the shoulder, which is about 4th of the distance from the edge to the centre, should be laid somewhat thicker than towards the edge, because the edge being lower than the centre, the enamel when in a fluid state in the fire, will flow down to it, and will thus produce an equality of thickness on all parts of the copper.

When the copper is covered, it must be carefully taken from the block, by gently raising it with the back of the thumb-nail, under the edge, and as near each of the feet as possible. After it is free from the wax, it may be lifted with the finger and thumb from the block, and placed under the lid of the box, to keep it from the dust till it is wanted to be fired.

Description of the Method of Hard Enamelling.

When the copper is nicely picked, fix it on the laying block, in the same manner as was directed for the glass enamelling, and lay a coat of glass enamel about two-thirds of the thickness that was directed for making glass plates. This must be fired till the enamel is melted down to a tolerably smooth surface; and when cold, should any specks of dirt appear on the surface, they must be cut out with the point of a square graver whetted to a very obtuse angle. After this, the plate must be put into a solution of nitrous acid and water, just strong enough to cleanse the scale from the edge of the copper, being careful not to leave the plate longer in the solution than is sufficient to clean the edge, and washing it immediately in clean water.

Let the plate now be fixed on the laying block, in the same manner as if it were a copper, keeping the wax soft enough to admit the feet to pass into it without any great pressure, as that might strain the enamel, and cause it to crack in the fire. Take a small quantity of the hard enamel, thoroughly purified of the acid by several waters, and, with the rounded part of the round-sided spatula, spread it as equally as possible over the whole surface of the plate. When this is done, the enamel must be dried by laying the corner of a clean napkin upon it till it has absorbed a part of the water. It will then be in a fit state to be spread more equally over the surface of the plate; and, when it is spread nearly smooth, and of equal thickness, it must be dried again with the napkin, and the spreading continued for full ten minutes, or longer, pressing harder.
ENAMELLING.

It rarely happens that any plate will come out of enamelling the first fire without a number of small black or green specks, which, perhaps, were in the enamel, and had escaped the notice of the operator. In addition to this imperfection, the union of so many small particles of enamel in one mass throws up to the surface a scummy and mottled appearance, which renders the plate, when cold, very unpleasing. It will be necessary to remove these imperfections by first carefully removing the specks with a square graver, whetted so that the face makes nearly a right angle with the plane of either side, observing to hold the index finger of the left hand immediately under that part of the plate where the speck is situated, so as to counteract the pressure given to the graver, and prevent any strain upon the whole, which might cause the enamel to crack when it again approaches the fire. When all the specks are removed, the centre hole of the copper, if all has been conducted right, will appear to rise above the surface of the enamel. This must be very carefully filed down, and the same operation practised at the edge, which will be found to have a similar appearance, and the plate is then ready to undergo a process, technically called using off. This is performed by rubbing the surface of the plate on a grit stone, with fine sand and water, until all the glazed appearance is completely obliterated, and one uniform and equally rough surface is produced. The intention of this part of the process, is to remove the mottled appearance on the surface, and give a more equal convexity to the plate. It may likewise be observed, that the flux in the enamel being always in the greatest quantity near the surface, gives a semi-transparent appearance to the plate. The using off removes this imperfection, and greatly increases the intensity of the enamel, adding at the same time much to its beautiful opacity. After the using off is completed, the plates should be brushed with a stiff haired brush and wet sand, to remove any light stain; when, being well washed in clean water, they must be dried with a clean napkin, and they are ready to receive the finishing fire.

As the specks that have been picked out generally leave some deep holes in the enamel, they must be filled up with some of the finest enamel, nearly as fine as flour; and being placed in a proper sized ring, must be set on the iron hearth of the furnace, gradually placing it nearer to the fire, until it attains such a heat as will permit it to be placed in the hottest part of the furnace without danger of cracking, which would be very likely to happen if this gradual annealing was not attended to. The ring and plate may now be lifted upon the planch with the tongs, and kept in motion, turning it gently round until it attains a white heat. As soon as this is observed, it must be brought out of the fire, and blown upon with the breath for two or three seconds, and immediately returned into the furnace, where it may be suffered to attain a white heat, which will bring it to a most beautiful gloss, and a degree of whiteness not to be exceeded. The plate must not be permitted to remain one moment longer in the fire after it has arrived at the desired heat, but must be quickly withdrawn from the furnace, and set to cool gradually; when, if it is found to be free from specks, the operation is finished, and the plate ready to have the figures painted upon it.

If the enamel should have any specks upon the surface, they can only be removed by the graver, and the firing repeated, omitting the using off in this case.
This is the process for firing and finishing the glass enamel plates. We shall now describe the method adopted to fire and finish the hard enamel dials.

The firing of these when the enamel is laid on, is the same as for the glass enamel, the apparatus being used for both purposes; but the heat applied to melt the Venetian hard enamel must not be so great, and the plate must be taken from the fire as soon as the enamel is found to form one tolerably compact body, as any longer continuance would have a tendency to spoil the intended shape of the plate, which is always considered a most essential quality in hard enamel plates. The method of using off the hard enamel plates is different from that made use of in the glass enamel; for as the proportion of flux in the Venetian hard enamel is considerably less than in the glass, and as diminishing the flux by using it off, (if carried to the extent we before described,) would render the surface very porous, great care is necessary to be observed that the flux may be raised to the surface in the first fire as little as possible; which is done by giving the plate a very slight heat, barely sufficient to unite the particles of enamel into one solid mass. Should any specks appear, they must be taken out with the graver, as was directed in the glass enamelling, and the surface must be reduced to perfect evenness, by rubbing it with a grey stone, or what is still better, the water of air stone found in Scotland, and now much used by mathematical instrument makers. This method of using off must be continued until the surface is smooth, and all the old or first gloss is removed. This part of the process should be very carefully performed, for should the plate receive any strain, it would be cracked in the fire, and inevitably spoiled, to prevent which, it will be best to hold the plate in the fingers of the left hand while being fired lightly over every part of its surface. The plate must then be well washed with very clean water; and to prevent any particles of the stone remaining in the pores, it is customary to rub the surface for about five minutes with a piece of soft smooth hoop wood, or what is still better, if it can be had, soft dog wood cut quite flat and smooth. When this is done, the plate must be well washed and wiped, and then be ready for the fire.

The heat for finishing may be rather more than that used in the first fire, as in that instance the intention was only to unite the particles of enamel into one solid mass. But the principal object in finishing being to raise the flux to the surface as much as possible, a greater heat may be used with advantage; but the plate must be taken from the furnace the instant that the surface appears bright and glossy.

We shall conclude our directions for firing the plates, with some general observations upon the accidents that are most likely to occur in both kinds of enamelling, and point out the best methods to remedy them when they happen. Where good Venetian enamels are obtained, and mixtures of various kinds are resortcd to, it frequently happens that the glass enamel plates crack when they are brought to the second fire. This is no doubt owing to the unequal expansion of the two enamels; and where the cracking takes place at the top or upper side of a plate, it requires very delicate treatment to preserve the dial from being completely spoiled.

To do this successfully, as soon as the crack is observed, the plate must be withdrawn from the fire; and if it extends only from the centre hole to the edge, it will, in most cases, bear mending, but if it has taken place in two or three places, it will be useless to make the attempt, as it will rarely succeed. If the dial plate was to continue in the fire, after it is cracked, a sufficient time, the enamel would close, and the plate become sound again. But as the copper on its surface is in a state of oxidation, the oxide of copper, uniting with the enamel, would rise to the upper surface of the plate, producing by its union a faint and sometimes a dark green line, which would evidently render the plate useless. The operator, therefore, must observe the time when the crack has opened to its greatest width; and before it unite or close at the bottom, the plate must be withdrawn from the furnace and allowed to cool. The opening must then be filled with fine enamel, laid sufficiently high to allow for its running down in the fire; but to adjust the quantity, so as to prevent the appearance of a seam across the plate, will require much judgment; and, indeed, however well the operation may succeed, it will still remain visible, because the mending cannot be submitted to the process of using off, as the plate would, by such means, be rendered in parts very porous, and thereby contract dirt when the fingers touch its surface.

Another very common accident in making glass enamel plates, is to over fire them, (as it is technically called.) Whenever this happens, the arsenic, which gives opacity and whiteness to the material, is converted into a flux by the extreme heat, and that part of the plate which has been so treated becomes semi-transparent and of a light blue colour. The only method that can be used in that case, is, to return the plate into the fire, and give it a long or close at the bottom, it will be best to hold the plate in the fingers of the left hand while being fired lightly over every part of its surface. The plate must then be well washed with very clean water; and to prevent any particles of the stone remaining in the pores, it is customary to rub the surface for about five minutes with a piece of soft smooth hoop wood, or what is still better, if it can be had, soft dog wood cut quite flat and smooth. When this is done, the plate must be well washed and wiped, and then be ready for the fire.

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Under the article Britain, will be found a history of the island from its first population by the Celts, until the arrival of the Saxons in 449. This people had been invited over from Germany by the Britons, to assist them in repelling the inroads of the Scots and Picts. Led on by Hengist and Horsa, two brothers, who were celebrated as among the noblest and bravest leaders of the nation, they soon finished the task which they were called to accomplish. The northern barbarians were unable to resist their valour. They were defeated in several encounters, and at last compelled to retire within their mountain barriers, which have ever since continued to form the boundaries of England and Scotland.

Vortigern, king of the Britons, rewarded his brave auxiliaries with large possessions in the country which they had delivered; but he soon found in them a more formidable enemy than those from which he had been freed. The Saxons in Germany, allured by the fertile soil and soft climate of Britain, flocked in great numbers to the standard of their countrymen. Conscious of their superior valour, they now thought of conquering the island for themselves; and from being the protectors, soon became the masters of the country. They soon found a pretext for quarrelling with the inhabitants; and, forming an alliance with the Scots and Picts, turned their arms against their former friends. The Britons, roused to indignation at such treacherous conduct, threw aside their indolence and effeminacy, and began to exert their ancient valour when it was too late. They deposed Vortigern, who had rendered himself despicable by his vices and his weakness, and entrusted their fortunes to his son Vortimer. Vortimer opposed the Saxon arms with various success. In one battle near Aylesford, Horsa, the Saxon general, was slain; but Hengist being continually reinforced by fresh troops from the continent, overcame all opposition, and spread his devastations over the whole country. In his bloody career, he spared neither age, sex, nor condition; the priests were slaughtered on the altars; and the bishops and nobility were mingled with the vulgar in the common calamity. Some accepted of life and servitude under their conquerors; and others fled to the continent, and gave to their new settlement the name of Brittany. But Hengist prosecuted his conquests until he extended his authority over the counties of Kent, Middlesex, Essex, and part of Surry, which was denominated the kingdom of Kent, and was the first Saxon state established in England. Hengist fixed his royal seat at Canterbury, and, after reigning 40 years, he died about the year 488.

Saxons, Angles, and Jutes, from Germany, encouraged by the success of their countrymen, from time to time, flocked in multitudes into Britain, and spread their conquests over the country, until the natives were either reduced to entire submission, or were compelled to seek for independence among the inaccessible mountains of Cornwall and Wales.

After a violent struggle of near 150 years, the Heptarchy, or seven Saxon kingdoms of Kent, Sussex, Wessex, East Anglia, Mercia, Essex, and Northumberland, were established in Britain; and the whole southern part of the island, except Wales and Cornwall, had changed its inhabitants, language, and customs. Kent, as we have observed, was founded by Hengist. Sussex owed its establishment to Ælla, a Saxon chief, who arrived with a band of adventurers in 477; and, after many battles with the natives, secured to himself the county of Sussex and a great part of Surry. Wessex, comprehended Hants, Dorset, Wilts, Berks, and the Isle of Wight, and was founded by Cerdic and his son Kenric. They landed in 495, but their progress was long retarded by the valour of the Britons. Nazan-Leod, who is styled by Henry of Huntingdon, "the greatest of all the British kings," assembled almost the whole strength of the natives to meet the invaders. A desperate battle ensued, which was long and obstinately contested on both sides; but the Saxons prevailed, and Nazan-Leod, with 5000 of his army, perished on the field. Upon the death of their king, the southern Britons applied for assistance to Arthur, prince of the Sires. This prince, by his wisdom and valour, supported their sinking cause. He is said to have defeated the enemy in twelve pitched battles; but his military achievements are so disfigured by the fictions of the bard, that some have even doubted of the existence of such a person. It is certain, however, that about that time the Saxons were opposed with considerable success; and it was not till after 55 years of almost constant warfare, that Cerdic was enabled to settle and enjoy his conquests. East Anglia, containing Norfolk, Suffolk, Cambridge, and the Isle of Ely, was established by Ælla, in 575; and about 10 years after, Crida laid the foundation of Mercia, which extended over seventeen counties, viz. Gloucester, Hereford, Worcester, Warwick, Leicester, Rutland, Northampton, Lincoln, Huntingdon, Bedford, Buckingham, Oxford, Stafford, Nottingham, Derby, Shropshire, Cheshire, and part of Hertford. The kingdom of Essex, under Erkenwin, was dismembered from Kent, and comprehended the county of the same name, with Middlesex and part of Hertford. Northumberland embraced the counties of York, Lancaster, Durham, Cumberland, Westmoreland, and Northumberland, with some of the southern counties of Scotland, and was at first divided into the kingdoms of Bernicia and Drieth. Ida established the first in 542; and Ælla the other nearly about the same time; but Adelfrid, the grandson of Ida, having married Aella, the daughter of Ælla, expelled her brother Edwin from his throne, and united the two kingdoms into one.

No sooner had the Saxons established their dominion over the country, and driven the natives from their homes, or reduced them to slavery, than dissensions and emulations began to appear among the conquerors. Fierce and uncivilized, they thought only of war. The
different states vied with each other in maintaining the ascendency over the rest; and all the misery, that ambition, treachery, or war could bring upon a people, was the consequence of their fierce contentions. A detail of their quarrels would neither be interesting nor instructive; indeed, the barbarous and credulous annalists of that age have so obscured the various events and revolutions of the Heptarchy by their exaggerations, that it would be impossible to produce any thing like a particular and continued narrative. It is sufficient to know, that, after above 200 years of almost continual animosity between the different kingdoms, Egbert, king of Wessex, by his prudence and valour, united them into one great state.

Egbert was of the royal family of Wessex, and a nearer heir to the throne than Brithric, the reigning monarch. His talents and promising virtues had excelled the jealousy of Brithric; and he was forced to retire into France, where, at the court of Charlemagne, he acquired those Hælthrythiochs which enabled him to prosecute, with such success, his schemes of conquest and aggrandisement. On the death of Brithric, he was called to the throne by the unanimous voice of his countrymen. His first efforts were directed against the Britons of Cornwall, whom he defeated in several engagements; but he was stopped in his progress by the intelligence, that Bemulf, king of Mercia, had invaded his dominions. Egbert met him at Ellandum in Wiltshire, and defeated him with great slaughter. Kent, Essex, and East Anglia, which had been subdued by the Mercians, became the prey of the victors; and Mercia itself was soon compelled to acknowledge the authority of Egbert. He allowed Wiglief, a Mercian, to retain the title, while he himself exercised the powers of a sovereign. The Northumbrians submitted upon the same conditions. Sussex had formerly been united to Wessex; and thus Egbert became sole monarch of England about the year 827.

Tranquility and union being now restored to the kingdom, Egbert by the conquests of Egbert, and firmly united under the dominion of this fortunate and valiant prince, they promised themselves the enjoyment of a permanent peace. But scarcely had Egbert established and regulated his infant monarchy, when a new enemy unexpectedly appeared on the coast. A swarm of barbarians from the shores of the Baltic, under the names of Danes and Normans, had filled the western countries of Europe with slaughter and devastation. Their first appearance in England was in the year 877. They afterwards made a descent upon Northumberland, where, being attacked by the inhabitants, they were defeated, and all put to the sword. They now entered the Thames, and having plundered the Isle of Shepey, retired without molestation. In 833, they landed a formidable army in Dorsetshire, where, being met by Egbert at Charmouth, they were routed with dreadful slaughter; and about two years after, being joined by the Britons of Cornwall, they made another descent upon Devonshire, where they were again defeated by Egbert at Hengistrow.

But the death of Egbert was the signal for new and more formidable invasions. His son and successor, Ethelwulf, was unable to stem the torrent of invasion. He had neither the valour nor abilities of his father; and began his reign by weakening the vigour of his government, in assigning part of his territories to his son Athelstan. The domestic dissensions which might have been the consequence of this partition of dominion, was prevented by the continual dread under which the whole kingdom was held by the inroads of the Danes. No place could be considered secure from their attacks. When repulsed in one quarter, they made their appearance in another, ravaging and destroying wherever they came; and carrying off to their ships, goods, cattle, and even the inhabitants. Though often defeated, they were not discouraged, but always returned with increasing numbers, till, after some years of various success, they firmly established themselves in the isles of Thanet and Shepey; from whence they made frequent and successful incursions into the neighbouring counties. During this distraction of public affairs, the piety of Ethelwulf carried him to Rome, where he remained about a year. He there bestowed many presents upon the principal ecclesiastics of that city; and made an annual grant of 300 mancuses to the see of Rome, for pious purposes. On his return, he found himself almost excluded from his throne. His eldest son, Athelstan, had been during his absence; and his second son, Ethelbald, had not only assumed the government of his brother's dominions, but had formed the design of removing his father from a station which his weakness and superstition had rendered him so ill qualified to fill. A civil war, however, was prevented, by Ethelwulf resigning the western part of the kingdom to his son, and retaining the eastern part to himself. Affairs being thus amicably adjusted, he convoked the states of the whole kingdom, and yielded to the importunities of the clergy, conferred upon them a perpetual grant of tithes, for which they had long contended; and exempted them at the same time from all public burdens whatever.

Ethelwulf survived this transaction only two years; Ethelbald and by his will, divided his dominions between his two eldest sons, Ethelbald and Ethelbert. The reign of the former was short and licentious. Ethelbert then became sole master of the kingdom, and governed in a manner more worthy of his birth. He was succeeded by his brother Ethberht, in 866.

The Danes still continued their incursions; and the Ethelred, valour of Ethelred, and his brother Alfred, who attended him in all his enterprises, was unable to stop their ravages. Encouraged by some partial successes, and the assistance they received from the East Angles, they now left the sea coast, and penetrated into the interior. They took up their winter quarters at Nottingham, but being dislodged from thence by the English monarch and his brother, they retired to Northumberland. They next established themselves at Reading, from whence they issued to the battles of Aston and Basing. In the former, the English were victorious; in the latter, the Danes prevailed; and Ethelred, having received a mortal wound, bequeathed the sceptre to his brother Alfred.

When Alfred ascended the throne, he was only 22 years of age. He had accompanied his father Ethelwulf in his pilgrimage to Rome, and on a second visit to that city, it is said, with many of his subjects; and when he then displayed, Pope Leo III. prognosticated his future greatness, and even gave him the royal anoint. His reign began with war. The Danes had overrun the kingdom, and treated the inhabitants with the greatest cruelty and scorn. They had fortified posts, and built castles for the defence of their borders, and the whole country was in some measure covered with their redoubts. Alfred, in his first engagement, near Wilton, was compelled to retire before
the superior numbers of the enemy. He continued, however, to harass them with such vigour, that they at last sued for peace, and agreed to evacuate the kingdom. But this, and several other similar treaties, were no sooner sworn to than violated; and the Danes being continually reinforced by fresh bands from Denmark, became so powerful, that, after various struggles, the English submitted, in despair, and Alfred was obliged to seek safety in disguise. He retired to Somersetshire, and attached himself as a servant to a near-herd, waiting in anxious solicitude for a favourable opportunity to resume his former dignity, and to bring deliverance to his country. Leaving this retreat, he secured himself, with a few followers, in the isle of Eathelingay; at the confluence of the rivers Thame and Parret, which was rendered almost inaccessible by the forests and morasses with which it was surrounded. From this place he made frequent and unexpected attacks upon the Danes, who often felt, but knew not who gave the blow. Here he remained a twelvemonth, when information was brought, that the Earl of Devonshire, who had been besieged by the Danes, in the castle of Kinvith, had routed the enemy, killed Hubba their chief, and taken the famous \textit{renfen}, or enchanted standard.

Alfred, animated by the success of his countrymen, was eager to encourage them by his presence; but being unable to procure any correct intelligence respecting the situation of the enemy, he resolved first to penetrate the Danish camp, which he did in the disguise of a harper. He found them indulging in idleness and careless security, and, having ascertained their numbers, and the strength of their position, he rejoined his followers. He then summoned his friends to meet him at Selwood forest, from whence he led them against the Danes. Filled with surprise at the unexpected appearance of an English army, and with terror at the name of Alfred, they made but a feeble resistance, and imploded the clemency of the conqueror. Alfred allowed them to settle in East Anglia and Northumberland, but stipulated, that they should immediately embrace Christianity. The Danes submitted, and Guthrum their chief, at baptism, was received by Alfred as his adopted son, under the name of Athelstan. The more turbulent, with Hastings at his head, retired to Flanders, in quest of plunder, and ravaged for a time the northern provinces of France.

England, shaken by so many violent convulsions, now enjoyed a state of tranquillity; and Alfred improved this period in regulating the internal administration of the kingdom, and providing for its future security. He rebuilt and strongly fortified the city of London, repaired the ruined cities, and raised castles and fortresses in different parts of the country. He established a regular militia, and built a fleet of 120 ships, which he stationed upon the coast, to prevent the approach of the piratical Danes. For several years the kingdom was secured from the ravages of these restless barbarians, until Hastings returned with a formidable army, and landed in Kent. Alfred hastened to the assistance of his people, and, after a long and arduous struggle, completely cleared the country of its invaders, and ruled, in full tranquillity, during the remainder of his life. He died in the 30th year of his reign, in the full strength of his faculties, and vigour of his age, an ornament and a blessing to the country which he governed. He may be considered as the greatest warrior, legislator, and scholar of the age in which he lived; and he deservedly attained the appellation of Alfred the Great, and the title of the founder of the English monarchy. For a more particular account of his character and exploits, see the article \textit{Alfred}.

Edward, the oldest surviving son of Alfred, and de-

Deeds of Edward.
ed the nomination of \textit{Elder}, as being the first monarch of that \textit{Elder} name that sat upon the English throne, inherited the kingdom and military genius of his father. His reign, from beginning to end, was a continued but a successful struggle against the Northumbrians and Danes. He had scarcely taken possession of his father's sceptre, when his claim to the throne was disputed by his cousin Ethelwald, who was the son of king Ethelbert, the elder brother of Alfred. Ethelwald having brought over the Northumbrians and Danes to his party, made an irruption into Gloucester, Oxford, and Wilts, where they exercised their usual ravages, and escaped with their booty before the king could assemble an army to oppose them. Edward, however, overran and ravaged East Anglia in revenge; but the Kentish men, when their sovereign retired, remained behind, in expectation of more plunder, and took up their quarters at Bury. Here they were attacked by the rebels; but made such a vigorous resistance, that Ethelwald fell in the action. Though freed from a dangerous rival, his exertions were still demanded to compel the submission of the Northumbrians, who, assisted by the Danes of Mercia, committed their devastations in the very heart of the kingdom. He routed them at Tatenhall, Tensford, and Maldon, and, at length, reduced them under his dominion. He improved the defence of his kingdom, by fortifying the principal cities. He forced the East Angles to swear allegiance to him; expelled the two rival princes of Northumberland; subjected several tribes of the Britons; and even obliged the Scots to give him marks of submission. It is said that he derived considerable assistance, in his enterprises, from the activity and prudence of his sister Ethelfleda, who was widow of the Earl of Mercia, and who retained the government of that province after her husband's death. This princess was distinguished for her masculine endowments, and disdaining the occupations of domestic life, employed her talents in directing the affairs of the cabinet or the field. She died before her brother, who, during the remainder of his life, held the government of Mercia. Edward reigned 24 years, and Athelstan, his natural son, succeeded to the throne.

The unsettled state of the kingdom required the mature age and abilities of Athelstan, in preference to the youth and inexperience of the legitimate children of Edward; and he found little difficulty in maintaining his pretensions. Some discontent attended his accession; but his authority was soon so firmly established, as to allow him to direct his attention to more distant objects. He marched into Northumberland, to provide against the future insurrections of the Danes. He found them impatient of the English yoke; but, in order the better to secure their allegiance, he conferred upon Sithrie, a Danish nobleman, the title of king, and gave him his sister Editha in marriage. On the death of Sithrie, however, which happened soon after, his two sons Anlaf and Godirid, by a former wife, seized upon the sovereignty; but Athelstan soon compelled them to fly, when the former took shelter in Ireland, and the other found protection from Constantine king of Scotland. Constantine thus incurred the displeasure of the English monarch, who demanded of him to surrender up his guest. Constantine at first consented; but, detest-
ENGLAND.

ing such treachery, assisted Godfrid to escape, who turned pirate, and soon after died. Athelstan, however, resenting this conduct, penetrated into Scotland, and exacted the most humble submission from the Scottish king. But no sooner had the English retired, than Constantine entered into a confederacy with Anlaf, and some of the Welsh princes, and made an irruption into England. Athelstan met them at Brunsbury, where they were overthrown with terrible slaughter, and Constantine and Anlaf with difficulty escaped. This monarch passed the remainder of his days in peace, employing his talents in the internal regulation of his kingdom. The encouragement which he gave to commerce, evinced a mind superior to the prejudices of that age; and he enacted a law, that a merchant, who had made three long sea voyages on his own account, should be raised to the rank of a thane or gentleman. He died at Gloucester, in the 16th year of his reign, leaving the kingdom to his brother Edmund.

The beginning of a new reign was always the signal for domestic convulsions. The Northumbrians again revolted, but were soon reduced to submission; and Edmund took this opportunity of removing the Danes from the towns of Mercia, and thus preventing any further disturbances in the heart of the kingdom. He also took Cumberland from the Britons, and conferred it on Malcolm king of Scotland, upon condition of his doing homage for it, and protecting the northern frontiers from the incursions of the Danes. His reign, however, was but short. Leof, a notorious robber, had presumed to seat himself at the same table with the king and his attendants at dinner. Edmund, enraged at his insolence, commanded him immediately to leave the room; the robber refused to obey, upon which the king, naturally choleric, seized him by the hair; but during the struggle, the dagger of Leof found its way to the heart of Edmund, who expired in the arms of his murderer. His children were too young to wield the sceptre of such a kingdom, and his brother Edred ascended the throne.

The Northumbrian Danes, as usual, rose in rebellion; but on the appearance of Edred with an army, they immediately submitted; and, to secure himself against their revolts in future, he placed garrisons in all their principal towns, and appointed an English governor to watch their motions. Edred, though neither destitute of abilities nor warlike vigour, became the slave of superstition. It was in this reign, that the celibacy of the clergy began first to be insisted upon; and this dispute, together with the introduction of a new order of monks, under the protection of Dunstan, abbot of Glastenbury, excited in the kingdom the most violent commotions. Dunstan had obtained a complete ascendency over the mind of Edred, and had the direction of the most important matters, both in the church and state. He had acquired, by his austerities, a high reputation for sanctity and devotion. Having lost the favour of the former king by his licentious manners, he determined to recover his character by a life of mortification. He secluded himself from the world, in a cell so small, that he could neither stand erect nor stretch out his limbs in it. Here he employed himself in penance and devotion; and pretended that he received frequent visits from the devil, whose strongest temptations he was enabled to resist. It is said that the evil spirit one day assailed him in the shape of a beautiful woman; but the saint discovering the deceit, seized him by the nose with a pair of red hot pincers, and held him there, till he made the whole country resound with his howlings. This and similar stories were not only industriously propagated by the monks, but seriously believed by the people; and Dunstan on his exaltation to the head of the treasury under Edred, supported with all his power the monks against the secular clergy. He had introduced celibacy into the convents of Glastenbury and Abingdon, and wished to make it universal throughout the kingdom. The secular clergy, however, were numerous and rich, and would not renounce the advantages which they enjoyed. The monks accordingly inveighed against the vices of the clergy, and stigmatised their wives with the name of concubines. These invectives produced retaliation on the part of their adversaries, and the whole kingdom was involved in religious contumelies and animi-

A.D. 914.

Edmund removes the Danes from the heart of the kingdom.

Is murdered by Leof, a robber.

A.D. 946.

Edred subdues the Northumbrian Danes.

A.D. 955.

Celibacy of the clergy introduced by Dunstan.
Edgar had long heard of the beauty of Elfrida, the daughter and heiress of Ogar, Earl of Devonshire; and his curiosity and desire were so excited, that he resolved, if report spoke true, to make her his wife. To ascertain, however, whether Elfrida was such a person as she had been described, he sent Earl Athelwold, his favourite, upon a pretended message to her father, with orders to bring him a correct account of the beauty of his daughter. Athelwold, as soon as he beheld Elfrida, was so overcome with her charms, that he forgot every other consideration but the gratification of his own passion, and demanded her from her father for his own wife. The favourite of a king was not to be refused, and they were married in private. Athelwold, pleased with the treacherous part which he had acted, returned with tidings very different from what Edgar had expected. He represented Elfrida as possessed of none of those accomplishments for which she had been so highly praised, and assured him that she was altogether unworthy the hand of a king. When he heard the thought of what from Elfrida, he took an opportunity, some time after, of remarking, that the fortune of Ogar's daughter, rendered her a very advantageous match for himself; and he requested permission to pay his addresses to her. Edgar, without hesitation, consented, and even recommended him to his parents. Athelwold returned to his wife, and had their nuptials solemnised in public; but, to secure himself against all possibility of detection, he used every precaution to detain Elfrida in the country, and to keep her at a distance from the eyes of the king. The enemies of the favourite, however, soon exposed him to his master; but Edgar, dissembling his resentment, merely expressed to Athelwold his surprise that he never brought his lady to court, and intimated his desire of being made acquainted with one of whom he had formerly heard so much. The favourite was thunder-struck at such an intimation, but could not refuse such an honour, and requested a few hours to prepare his wife for the king's reception. He was at her bed, confessed the treachery of which he had been guilty, and intreated her, if she had any regard for his life or her own honour, to conceal, by every means, from his sovereign, that beauty which had been so fatal to his fidelity. Elfrida promised obedience; but, instead of complying with the wishes of her husband, she was exasperated against him for having deprived her of a crown, and with the hope of still captivating the heart of Edgar, appeared before him in all her charms. The monarch was overcome by her beauty, and determined to obtain her; but for the present concealed his sensations from Athelwold, who was soon after, however, secretly murdered by the king's command, and Elfrida was raised to the throne. Such was Edgar; yet Edgar was placed by the monks among the number of the saints. His reign is remarkable for the extirpation of wolves from England. He himself took great pleasure in hunting these animals; and he changed the tribute which had been imposed upon the Welsh princes by Athelstan, into an annual tribute of 300 wolf-heads, which produced such diligence in destroying them, that they soon became extinct in the island. 4
England, and his the voice at harbour. A. 9T3. of the horse, of he hind. Edward, Elfrida his, and the clergy. However, was rendered unsuccessful, by the treachery of Alfric, Duke of Mercia, whose repeated perfidy brought many calamities upon his country, and whose name is infamous in the annals of that age. He informed the enemy of their danger, and even deserted to their standard. But such was the weakness of the English court, that it was found necessary again to entrust this nobleman with his former government.

The Danes now began to feel their superiority; and the divisions among the nobility, and the weakness of the king, encouraged them to continue their incursions. In 993, Sweyn, king of Denmark, and Olave, king of Norway, sailed up the Humber with a considerable force, and spread their ravages all around. The army which was assembled to oppose them, was defeated in battle by their leaders, Ferna, Prithgeud, and Godwini, who were all of Danish extraction, and offered an easy victory to the invaders. Encouraged by this success, and inspired with contempt for such an enemy, they penetrated into the heart of the kingdom, and were stopped in their depredations only by another compromise. Ethelred promised them subsistence and tribute, if they would leave the kingdom. The sum of L.16,000 was immediately paid, and they soon after departed. A short respite was the only consequence of this compromise. The Danes again appeared, and laid waste, with fire and sword, the whole southern coast, from the Severn to the Thames. The miseries which the English now suffered, reduced them almost to despair; and they had again recourse to the expedient of buying tranquillity with money. But the invaders rose in their terms, and demanded L.24,000, to which they had the meanness to submit. Ethelred saw that there was no end to these submissions, and betook himself of other expedients to resist these merciless ravagers. He entered into an alliance with Richard Duke of Normandy, by receiving Emma, the sister of this prince, in marriage; and he further endeavoured to secure the peace of the kingdom, by getting rid of his Danish subjects. Many of these had been employed as mercenaries by his predecessors; but, instead of defending the inhabitants against their invaders, they generally took part with their countrymen, and assisted in their depredations. They had also rendered themselves most obnoxious to the English, by their violence and licentiousness; and the animosity which subsisted between the two nations was at its height, when Ethelred formed the bloody and impolitic purpose of massacring all the Danish troops throughout his dominions. The festival of St. Brice (Nov. 13. 1002) was fixed for the execution of this design, and secret orders were dispatched to commence it everywhere on the same day. The

The king murdered by Elfrida. A. D. 973.

Ethelred's weak reign.
populace, enraged by the recollection of former injuries, and stimulated by the commands of their rulers, did not distinguish between innocence and guilt, and spared neither age nor sex. Even Gunilda, the sister of the Danish monarch, who had married Earl Polding, and had embraced Christianity, was included in the fate of her countrymen.

This barbarous and perfidious policy, however, instead of relieving the English from their miseries, was only a prelude to greater misfortunes. Sweyn, king of Denmark, exasperated by the slaughter of his countrymen, and of his own sister, soon filled the kingdom with his vengeance. The English, though now prepared to make a vigorous resistance, were dispirited and betrayed by their leaders. Alfric, the commander of the English armies, feigned sick, and refused to lead them against the enemy. Their calamities were augmented by famine; and they were obliged to buy a precarious peace with L.30,000. New and formidable preparations were made against the return of the enemy. Every proprietor of eight hides of land, was commanded to provide a horseman and a complete suit of armour; and those possessing 310 hides, were to equip a ship for the defence of the coast. This equipment amounted to about 800 ships, and 50,000 men. But all these preparations were frustrated, by the treachery of Duke Edric, and the animosities and factions of the nobility. Edric had succeeded his father Alfric in the government of Mercia, and in the command of the English armies; and had married the king's daughter. He was even a greater traitor than his father, and, like him, found it his interest to prevent all successes that might tend to establish the royal authority, and consequently endeavour to counteract every plan that was formed for the defence of the country. General consternation, and mutual disaffection and dissension, prevailed. The enemy appeared in every quarter of the kingdom. The governors of one province refused to march to the assistance of another. General councils were summoned, but nothing was done; and they at last agreed to stipulate for peace at the expense of L.48,000. The Danes accepted the money; but finding themselves masters of the country, disregarded the treaty. They continued their ravages, and under new contributions; and the nobility saw no prospect of relief by acknowledging allegiance to the Danish monarch. Ethelred immediately fled to Normandy, whither he had previously sent his Queen Emma and her two sons, and where they were treated by Richard with every mark of kindness and honour.

Sweyn, however, survived his exaltation to the throne of England but a few weeks, and Ethelred was recalled by the prelates and nobles. But adversity had wrought no change upon his character, and cowardice and credulity were its prominent features. His son-in-law, the perfidious Edric, notwithstanding his repeated treasons, still retained his influence at court. Affairs soon became as desperate as formerly; and the English found in Canute, the son and successor of Sweyn, an enemy no less terrible than his father. He ravaged the eastern coast with merciless fury, and then broke into the counties of Dorset, Wilts, and Wiltshire. An army was there assembled to oppose him, under the command of Prince Edmund, the eldest son of Ethelred, and Duke Edric. But Edric again betrayed his trust; and, after attempting to get the Prince into his power, he deserted to Canute. Edmund still kept the field, but was obliged to commit equal ravages with the Danes, in order to procure supplies for his soldiers. He afterwards retired to London, determined to lose the capital only with his life. On his arrival there, however, he found every thing in confusion by the death of the king, who expired after an unhappy reign of 38 years. Edmund immediately ascended the throne. He was surnamed Ironside, from his hardy valour; but his abilities and courage, though great, were unable to save his sinking country. He protracted for a while an unequal war, but was at last obliged by his subjects to put an end to those convulsions, by dividing the kingdom with his rival. Canute retained the northern division, consisting of Mercia, East Anglia, and Northumberland, while Edmund kept possession of the southern part. He was soon after murdered at Oxford by his two chamberlains, at the instigation of the infamous Edric.

The tender years of Edmund's children, were unable to oppose the ambition and the power of Canute. But to give some appearance of justice to his usurpation, he pretended that in the last treaty with Edmund it was agreed, that, in case of Edmund's death, Canute should either succeed to his dominions, or be guardian to his children. He had no sooner taken possession of the throne, than he sent the two sons of Edmund to Sweden, with secret orders to the king, to free him from all future anxiety by their death. The Swedish monarch, too humane for such a deed, sent them to be educated at the court of Hungary. Edwin the elder brother died without issue, and Edward married Agatha, the sister-in-law of the king of Hungary, by whom he had Edgar Atheling, Margaret, afterwards queen of Scotland, and Christina, who retired to a convent.

Canute, to secure himself in his dominions, cut off many of the English nobility on whom he could not rely, and whom he hated on account of their disloyalty to their former sovereign; and among the rest perished the traitor Edric, who was publicly executed, and his body thrown into the Thames. He then married Emma, the queen of Ethelred, whose children, supported by their uncle Richard Duke of Normandy, had laid claim to the English throne, and thus he acquired both the friendship of that prince, and the confidence of his English subjects. Though the beginning of Canute's reign was marked with severity and injustice, he afterwards reconciled the English to the Danish yoke, by impartiality of his administration. He made no distinction between the two nations in the distribution of justice; he restored the Saxon customs in a general assembly of the states, and thus gradually incorporated the Danes with his new subjects. Having firmly established his power in England, he made an expedition to Denmark, to resist the invasion of the Swedes. Here Earl Godwin, and the English troops under his command, performed such important services, that the King gave him his daughter in marriage, and treated him ever after with the greatest confidence. Canute afterwards attacked and added Norway to his dominions; and also compelled Malcolm king of Scotland, to acknowledge himself a vassal to the English crown for the county of Cumberland. The latter years of his life were spent in the exercises of religion. He undertook a pilgrimage to Rome, built churches, and endowed monasteries; and died at Shaftesbury, the greatest and most powerful monarch of his time, after a reign of 18 years. He left three sons, Sweyn and Harold by his first wife Alfwyn, the daughter of the Earl of Hamps-
In the treaty with the Duke of Normandy, Canute had stipulated, that he would leave his kingdom to the children of Queen Emma; but, Hardicanute being yet a minor, and unfit to rule such an extensive and newly conquered kingdom, he left the succession to Harold. Hardicanute, however, was supported by Earl Godwin, the most powerful nobleman in England; and a civil war would have been the consequence, had they not agreed to divide the kingdom between them. Harold had London, with all the provinces north of the Thames, and the southern parts were assigned to Hardicanute. Queen Emma immediately fixed her residence at Winchester, and governed in the name of her son.

The ambition of Harold, who was remarkable for no virtue, and whose only accomplishment was agility in running, by which he acquired the surname of Harcfoot, was not satisfied with a divided authority; and his fears were awakened by the recollection, that he had other competitors in Alfred and Edward, the two sons of Ethelred. These princes had arrived from Normandy, on a visit to their mother at Winchester; and Harold, having gained over Earl Godwin by promising to marry his daughter, resolved to get rid of his fears by their death. Alfred was accordingly invited to London, under the mask of friendship, and was waylaid by the vassals of Earl Godwin, who, having murdered 600 of his attendants, seized him as a prisoner, put out his eyes, and threw him into the monastery of Ely, where he soon after died. Emma and Edward were no sooner apprized of Alfred's fate than they left the kingdom, when Harold took possession of his brother's dominions.

A. D. 1039.

His triumph, however, was but short. He died after a reign of four years, neither regretted nor esteemed by his subjects.

Died of a debauch.

A. D. 1041.

Edward, surnamed the Confessor, the son of Ethelred, was called to the throne by the universal consent of the nation. The English were overjoyed at the restoration of their native prince, and congratulated themselves with the hope of their never again being subject to a foreign dominion. The only fear of opposition on this occasion was from Earl Godwin, between whom and Edward there subsisted an open animosity, on account of the murder of Prince Alfred. Edward, however, was obliged to soothe his resentment for the present. He submitted to a reconciliation, and, as a pledge of his sincerity, he promised to marry Editha, the daughter of Godwin. New causes of dissension soon arose. Edward, who had been educated in Normandy, had contracted a partiality for the manners and usages of that country. Whatever was Norman was sure to meet with his favour. His court was, consequently, in a short time crowded with foreigners, who soon introduced their customs and language among the natives. The attention and confidence of the king was chiefly confined to these strangers. He bestowed upon them the highest ecclesiastical prelatures; and the seats of Canterbury, London, and Worcester, were filled by Normans. This excited the jealousy of the English, particularly of Earl Godwin, who had also been irritated by the treatment which his daughter had met with from Edward. The reconciliation of the king with that nobleman was forced upon him by political considerations; but he could not bring himself to bear the injuries he had suffered. His hatred to the father was transferred to the daughter; and the beautiful Editha, though possessed of many amiable accomplishments, could never acquire the love of her husband. It is even said, that, during the whole course of her life, this frigid monarch abstained from all matrimonial intercourse with her; and it is asserted by the monks, that he married this princess purely to exercise his virtues, by withstanding a continual temptation; and it was for this absurd continence, whether pretended or real, that he obtained the title of Saint, or Confessor. As Godwin, however, could not openly assign this as a ground for disaffection, he seized upon the more popular pretence—the great power and influence of the Normans in the government; and an occasion was soon offered him for declaring his animosity, and bringing it into action.

The Count of Boulogne, on his return from a visit to the court of England, had been stopped at Dover by a tumult of the populace, which had been excited by the insolence of one of his vassals, and from which he had difficulty escaped. He hastened back to Edward, and complained of the ill treatment which he had met with. The king immediately ordered Godwin, under whose jurisdiction Dover was, to punish the inhabitants. Godwin, instead of complying, threw the whole blame of the disturbance upon the Count and his followers; and, under pretence of preparing for an expedition against the Welsh, he assembled a large army, and marched directly to Gloucester, where Edward then resided. The king, totally unprepared for such a proceeding, endeavoured to gain time by negotiation. In the meanwhile, he was joined by Siward, Duke of Northumberland, and Leofric, Duke of Mercia, and soon assembled an army sufficient to set his opponent at defiance. He immediately proceeded to London, and summoned a council to judge of Godwin's rebellion. That nobleman, finding himself unable to make head against the power of his sovereign, fled into Flanders with his three sons, Guitli, Sweyn, and Tosti; while Harold and Leofric, two others of his sons, took shelter in Ireland. Their estates were immediately confiscated; and Queen Editha was confined in a monastery at Wareweal.

Godwin, however, was not discouraged by this unpromising aspect of affairs; and he was too strongly supported by powerful alliances both foreign and domestic, to remain quiet under his misfortunes. He assembled an armament in Flanders; and, when a favourable opportunity presented itself, he set sail for the Isle of Wight, where he was joined by his son Harold with a squadron from Ireland. They traversed all the southern coast, entering the harbours, and carrying off the ships. Edward had no fleet capable of opposing them; and, as they declared that they came only to procure justice for themselves, and to relieve their country from the tyranny of foreign influences, they were soon reinforced by great numbers. They with an army then entered the Thames, and appeared before London. The king was compelled, by necessity, to come to an accommodation. It was agreed, that Robert, archbi-
shop of Canterbury, who was a Norman, and the most obnoxious of his countrymen, should be banished, and that Godwin should give hostages for his future obedience. This turbulent nobleman was thus reinstated in all his former power; but his hostages, for greater security, were sent by Edward to his kinsman, the Duke of Normandy. Godwin's death, however, relieved the king, for a time, from farther disquietude; but his son Harold inherited the power and ambition of his father, and was superior to him in talents and in virtue. By his insinuating address, he had softened, in some degree, the hatred which Edward had always borne to him; and his popularity was daily increasing, by his generosity and affability of manners.

The king saw the growing authority of Harold, but had not vigour to oppose it; and at last had recourse to the dangerous expedient of setting up as a rival, Algar, the son of Leofric, Duke of Mercia, who possessed the government of East Anglia. Algar, however, was unable to stand before the power and the intrigues of Harold, whose influence obtained his expulsion from his government, and his banishment from the kingdom; and the death of Algar, and his father Leofric, which happened soon after, freed Harold from any farther apprehension from that quarter. His power was also considerably augmented, by the accession of his brother Tosti to the dukedom of Northumberland. Sиward, the former duke, had greatly distinguished himself, by an expedition to Scotland against the usurper Macbeth, whom he defeated and killed in battle, and restored Malcolm Kenmore to the throne of his father; but he lost in that enterprise his eldest son Osbern; and as his second son, Wulstan, was too young to be entrusted with such a government, Harold had the influence to procure it for his own brother. Edward could not but perceive, that this nobleman was aiming at the succession to the throne; and, as he felt himself broken down by age and infirmities, he invited his nephew Edward, the son of Edmund Ironside, from Hungary, and appointed him his successor in the kingdom. The death of that prince, however, which happened a few days after his arrival in England, and the tender age and inexperience of his son Edgar Atheling, threw the king into new difficulties. He still retained his dislike to the family of Godwin; and could not brook the idea, that they who had risen on the ruins of his authority, should succeed to his throne. He therefore cast his eye on his kinsman William, Duke of Normandy, and even secretly commissioned Robert, archbishop of Canterbury, to inform William of his intentions.

Duke William had displayed the greatest abilities, both as a statesman and a warrior. He had come to the government when a minor; and the regency established by his father could with difficulty maintain themselves, amidst the dangers of foreign invasion and internal dissension. But the prince no sooner came to maturity, than he struck terror into his enemies, by the vigour and wisdom of his administration. His valour and conduct prevailed in every action. He compelled his invaders to retire; reduced his turbulent and licentious barons to submission; and soon established his dominions in complete tranquillity. The intelligence of Edward's intentions excited his ambitious hopes; and he endeavoured, by every means, to secure his object. Harold, however, was equally unremitting in establishing his power, and preparing for the expected vacancy. He had extorted, by his intrigues, the king's consent to release the hostages which had been given by his father, and which were still in the hands of the Duke of Normandy. He was unwilling that such near relations should remain prisoners in a distant country, and was afraid that they might be retained as pledges for his own good behaviour, in the event of any dispute about the succession. He therefore had no sooner obtained Edward's sanction for their release, than he set sail with a numerous retinue for Normandy. He was driven by a tempest on the territories of the Count of Pontchen, who, being informed of his quality, detained him prisoner, and demanded an exorbitant sum for his ransom. Harold, however, found means to acquaint the Duke of Normandy with his situation; and William immediately seized this favourable opportunity of gaining over Harold to his views. Insinuating to this powerful nobleman, he thought his succession to the throne of England would be secured; and he accordingly compelled the Count of Pontchen to set him at liberty, and received him at Rouen with every demonstration of respect and esteem. They were both ignorant of each other's pretensions; and Harold was not a little surprised, when he heard, for the first time, of the intentions of Edward to make William his heir. He was obliged, however, to conceal his feelings. William offered him his daughter in marriage, and promised to raise his family to still greater honours, if he would assist him with his power. He also required him to take an oath that he would be true to his engagements: to all of which, Harold was obliged to feign compliance; and they parted with all the appearance of mutual friendship.

The ambition of Harold soon made him forget the oath which had been extorted by necessity; and the discovery of Edward's design tempted him the more to strengthen his power, and augment the number of his friends. He took every opportunity of encouraging the English in their hatred to the Normans, and always deprecated their subjection to foreign influence. He thus attempted to reconcile them to his succession; and, by a show of great power and influence, he deterred Edward from openly declaring his intention in favour of William.

About this time, Harold also acquired very general favour, by an opportunity which he had of displaying his abilities and justice. The Welsh, under their prince Griffith, had made repeated inroads, and committed great depredations on the frontiers, and had been always able to shelter themselves from pursuit among their inaccessible mountains. Harold was determined to repress these troublesome plunderers. He attacked them both by sea and land, and followed up his successes with such vigour, that, in order to save themselves from total destruction, they were compelled to deliver up the head of their prince, and submit themselves to the authority of Edward.

An insurrection had also broken out among the Northumbrians, which was headed by Morcar, Duke of Mercia, and his brother Edwin; and which had been occasioned by the tyrannical temper and injustice of Duke Tosti. Harold was commanded by the king to suppress the insurgents; and he marched a considerable army into Northumberland for this purpose; but, before coming to action, Morcar, relying on the generous disposition of his opponent, requested to be heard in his own defence; when he represented, in such strong colours, the cruelties and indignities which the Northumbrians had suffered from Tosti, and their determination to perish rather than be exposed to a renewal of them, that Harold abandoned his brother's cause, and refused to be the instrument of his tyranny. He even
Edward, worn out with age, weak and irresponsible, though hostile to the claims of Harold, yet employed no decisive measures for securing the succession to the Duke of Normandy; and, while still undetermined how to act, he was cut off by death in the 65th year of his age, and 25th of his reign. Harold immediately ascended the throne without opposition. The voice of the people supported his claim, and he was crowned the day after Edward’s death, by Aldred, archbishop of York. His private virtues also entitled him to a crown, which might be considered as elective; but he possessed but for a short time what he was so worthy and able to wear. William of Normandy could not conceal his disappointment, at the intelligence of Harold’s exaltation; he had indulged himself with the hope of an easy accession to the crown of England; but he now saw it torn from his brow, by one equal in abilities to himself, and who had acquired, by his many virtues, the love and confidence of his subjects. His indignation burst forth in menace and upbraidings: he dispatched an embassy to Harold to reproach him with his breach of faith, and to demand an immediate renunciation of the throne of England, of which, by the will of Edward, he was the rightful heir. Harold coolly replied, that an oath was only binding when voluntary: his was extorted by fear, and therefore could not be regarded as obligatory. He had obtained the crown by the unanimous voice of the nation: he should prove himself worthy of their choice, by maintaining to the last those liberties which they had entrusted to him; and he was determined to lose his kingdom only with his life. William was prepared for this answer; and, as he had resolved upon prosecuting his claim by force of arms, he continued his levies. His intention was no sooner made known, than he was joined by numerous adventurers from different parts of Europe, who, impatient of peace and tranquillity, were ready to embark in any enterprise which promised them plunder or renown. He thus found no difficulty of completing his armament, which, besides his own troops, who were distinguished for their valour and discipline, was composed of the flower of the continental warriors, commanded by the most celebrated champions of the age. He was also encouraged by the Emperor Henry IV, who promised to guarantee his Norman dominions during his absence; and by Pope Alexander II, who sent him a consecrated banner, and a ring with one of St Peter’s hairs in it.

William, in order to divert Harold’s attention from his own preparations, and to embarrass his affairs the more, seduced Tosti, and Halfagar, king of Norway, to make a descent upon England. This they did with a considerable army, and overran all the northern parts of the kingdom. They were first opposed by the Dukes of Northumberland and Mercia, whom they defeated and put to flight; but Harold having hastily collected an army, engaged them at Stamford. The Norwegians made a most obstinate resistance, but were at last totally routed. Tosti and Halfagar fell in the action; and the Norwegian fleet became the spoil of the conqueror. Prince Olave, the son of Halfagar, however, was generously restored to liberty, and allowed to depart with 20 vessels.

The news of this defeat spread the greatest joy throughout the kingdom; but their joy was soon repressed by the intelligence, that the Duke of Normandy had landed in Sussex with a formidable army of 60,000 men. William had been some time detained by contrary winds; but, as Harold had dismissed his fleet, on receiving false intelligence that William had discontinued his preparations, he met with no other obstacles in his voyage. He quietly disembarked, and prepared for the arrival of the enemy.

The victory of Stamford had so weakened the English army, that it may be regarded as the cause of Harold’s subsequent overthrow. He had lost many of his bravest officers and soldiers, whose place he could supply only with raw and undisciplined troops, little capable of resisting the discipline and valour of the Normans. Elated, however, with success, and relying on the confidence and bravery of his subjects, he hastened forward to meet his new invader. His brother Gurth renounced his fortunes on the issue of a battle, while he had easier means of victory in his power. It was depriving himself of those very advantages which he possessed over the invader. He was in the midst of his resources, surrounded and beloved by his people; while the desperate situation of the enemy required a speedy termination to the contest. The Norman leader possessed the greatest military talents, and his troops had been long familiar with conquest. Their valor and discipline rendered them more formidable than their numbers; and, as they had full confidence in the abilities of their chief, they would fight to the last extremity. But if their ardour was allowed to cool for want of action; if they were harassed with skirmishes, and straitened in provisions, they would be compelled to retire, or fall an easy and bloodless prey. If, however, he was determined upon an engagement, he entered him not to risk his own person, and thus deprive his country of its chief resource in resisting a foreign dominion.

Harold was deaf to persuasion, and approached the Norman camp at Hastings. He offered William a sum of money if he would depart the kingdom. William returned, that he must resign the kingdom, or hold it of him in fealty, or submit his cause to the pope, or fight him in single combat. Harold replied, that the god of battles would determine their differences.

The hostile armies were encamped in sight of each other during the night, and waited with anxiety for the return of day. The English passed the night with songs and feasting; the Normans in silence and prayer. The dawn of morning beheld both armies in battle array. William harangued his soldiers on the greatness of the prize for which they were to contend; and represented to them the inevitable destruction which awaited them, should they fail of success. His army was divided into three lines: the first, consisting of archers and light-armed infantry, was led by Roger de Montgomerie; the second, composed of heavy-armed battalions, was commanded by Charles Martel; while he placed himself at the head of the cavalry. They advanced to the attack, singing the song of Roland. Harold had drawn up his army on a rising ground, and had secured his flank by deep trenches. He commanded on foot the Kentish men, who were placed in the van, and encouraged his troops, by sharing with them the post of danger. He was resolved to stand
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The Norman cross-bows at first dreadfully gall'd the English; but as they came into closer action, the English bills mowed down their ranks, and checked the fury of their onset. The combat was long and desperate, and disputed with equal bravery on both sides. The Normans at length began to give way; William saw the imminence of his danger, and hastened with fresh forces to the support of his retreating bands. His presence revived the courage of his followers, and the English were in their turn compelled to retire. Aided, however, by the advantage of the ground, and animadverted by the voice and example of their king, who had toiled all day in the front of the battle, they renewed the fight, and the Normans were falling in great numbers. William, finding that he could make no impression on the enemy's position, ordered his troops to make a sudden retreat, and deceive them by the appearance of a flight. The artifice succeeded. The English followed them to the plain, when the Normans suddenly facing about, and attacking them in both flanks with their cavalry, drove them back with great slaughter. They were again rallied by the bravery of their prince; and though William repeated the same stratagem, yet the English were enabled still to maintain themselves in firm array, and seemed determined to dispute the victory to the last. But the death of Harold, who was slain by an arrow while fighting in the foremost ranks, decided the battle in favour of the Normans. The English were dispirited by the loss of their brave but unfortunate leader, and gave way on all sides. The victorious invaders followed up their success with dreadful slaughter: but darkness soon put an end to their bloodshed. In this memorable action, the Normans lost 15,000 warriors, and the duke had three horses killed under him. The loss of the English was still more considerable; besides the death of their king and his two brothers. The body of Harold could scarcely be distinguished among the heaps of slain. It was brought to William, who restored it without ransom to his mother. The Normans gave thanks to heaven for their victory on the field of battle; and immediately prepared to improve, to the utmost, the advantage they had gained.

The English, considering their great resources, might have done much to retrieve their affairs; and had they been unanimous, might have worn out their invaders by a protracted warfare. But they were divided and dismayed. The intelligence of the battle of Hastings spread terror and consternation throughout the kingdom, and no one appeared to whom the nation could entrust its fortunes. Edgar Atheling was proclaimed king, and Morcar and Edwin, Harold's brothers-in-law, endeavoured to make a stand in his defence. But their plans were disconcerted by the rapid advance of the conqueror to the capital. The clergy were the first to bow before his consecrated standard, and even insisted that the pope's bull called for general submission to the authority of William. On his approach, Edgar, the new elected king, with Stigand, Archbishop of Canterbury, and the chief nobility, entered his camp, and made him a formal offer of the crown of England, upon condition that he would govern according to the customs of the country. Though by right of conquest he could have demanded the crown, yet he chose rather to accept it as a voluntary gift; and he was consecrated in Westminster Abbey, by Aldred, Archbishop of York. Edwin and Morcar, who had retired with their troops to their own provinces, and others of the principal nobility, who were not present at the coronation, soon after came and swore fealty to the new sovereign.

The beginning of William's reign was marked with mildness and humanity. Though all real power was placed in the hands of the Normans, he took care that they should use it with moderation. Every disorder or oppression met with severe punishment. He built citadels in London, and other towns best situated for commanding the kingdom, where he quartered his army, among whom he had distributed considerable sums as the reward of their valor; but he governed them with rigid discipline, and restrained every appearance of insolence towards the natives. He received, with affability, all who approached his person, and seemed desirous that the two nations should live in the closest amity.

Peace and tranquillity seemed now to be firmly established; and William, nowise apprehensive of any disturbances by his new subjects, went over to Normandy to receive the congratulations of his countrymen. His brother Odo, Bishop of Bayeux, and William Fitz-Osborne, were entrusted with the administration of the kingdom during his absence; and the better to secure their authority and the fear of chief of the English nobility. These not only served to grace his court by the magnificence and costliness of their equipages, but might be considered as hostages for the fidelity of the nation. His departure, however, was soon followed by conspiracies and insurrections. The Norman captains, no longer under the eye of their sovereign, grudged the restraints which had been imposed upon their rapine, and treated with contempt a people who had surrendered their liberties so easily. Their insults and depredations produced a general disaffection among the English, which in some places broke out into open rebellion. A secret conspiracy was even formed for a general massacre of the Norman soldiery, which was to take place on Ash Wednesday, during the time of divine service, when the Normans would be unarmed; and Earl Coxe was murdered by his vassals, because he refused to join in this enterprise. The presence of William, however, disconcerted all their schemes. Many of the conspirators fled, whose estates were forfeited, and his Norman followers; and, as a further mean of gratifying their rapacity, he renewed the tax of Danelagel, which had been so odious to the nation. This only produced new insurrections. In Exeter, Cornwall, and Devonshire, the inhabitants took up arms, but were soon suppressed. But in the north they assumed a more formidable appearance. Edwin and Morcar, impelled by private injuries, as well as public wrongs, and encouraged by the promise of assistance from Wales, Scotland, and Denmark, resolved to attempt the deliverance of their oppressed countrymen; but they were surprised by the king before any of the foreign succours had arrived, and were obliged to submit to his clemency. They were pardoned and restored to their possessions; but their followers were treated with greater rigour, and their lands were divided among his foreign adventurers. Many fied from oppression into foreign countries; and Edgar Atheling, distrusting the insidious caresses of William, sought refuge with his two sisters, Margaret and Christina, in the court of Malcolm King of Scotland, who soon after married Margaret, and treated with kindness all the English exiles who sought his protection. William now began to view the English as unworthy of his clemency, and
as a people on whom he could place no dependence; and henceforth he was determined to treat them with the utmost rigour. All offices of trust and confidence were consequently bestowed upon the Normans, who committed continual insults and depredations.

Finding no redress for such injuries from their governors, the English took vengeance with their own hands, and assassinated Normans were daily found in the woods and highways, without any possibility of bringing the perpetrators to justice. Many of the Norman chiefs finding themselves continually exposed to the fury of an incensed people, and under constant apprehensions of danger, longed for the peace and security of their native country. They desired to be dismissed from the service, which William granted, but at the same time resented, by confiscating all their possessions in England. New insurrections were followed by new forfeitures and attainders; and the Normans found it their interest to instigate rebellion, as they were sure to be benefited by its suppression.

The three sons of Harold, Godwin, Edmund, and Magnus, who, after the battle of Hastings, had retired to Ireland, encouraged by the general dissatisfaction of the English, made a descent with a considerable force on the coast of Devonshire; but, being defeated in several actions, they were compelled to return to their ships. About the same time, the Northumbrians again took up arms, who, being joined by Edgar Atheling and the chief of the English exiles from Scotland, and assisted by a body of Danes, attacked the Norman garrisons of Durham and York, and put every man to the sword. The inhabitants of the southern counties had also risen, and a general effort seemed now to be made for the recovery of their liberties; but it proved only the means of rivetting their chains more closely. William having bought off the Danes, and encouraged his followers with the hope of plunder, inflicted a signal punishment on the restless Northumbrians. He laid his desolating hand upon their fertile country between the Tees and the Humber, for the extent of about 60 miles; burned their habitations; destroyed their implements of husbandry; and drove away their cattle. The inhabitants were compelled to seek for subsistence in the southern counties of Scotland; but about 100,000 are said to have perished miserably in the woods, of cold and hunger. The other malcontents had submitted to the conqueror, except Hereward, a nobleman in East Anglia, who took shelter in the Isle of Ely, and continued his inroads into the neighbouring country.

William, however, to prevent any repetition of such disturbances in future, transferred almost the whole of the landed property in England into the hands of his Normans; and for this injustice he considered it a sufficient pretence, that most of the ancient proprietors had been involved in conspiracies and insurrections against his government. Many noble families were thus reduced to beggary, and had the mortification of seeing the meanest and lowest of their enemies possessing their castles and demesnes. He next divided the kingdom into baronies, which he exclusively conferred upon the most considerable of his followers, with the reservation of stated services and payments. These amounted to about 700, who again parcelled out their lands, with similar conditions, among their vassals or knights; of which there were 60,215. As the English were totally excluded from the first rank, those who still retained any property were glad to be received as knights, under the protection of some powerful Norman. The clergy also felt the effects of his resentment. All Englishmen were expelled from the higher offices of the church, which were immediately filled by foreigners; and the Bishop of Worcester was the only English prelate that was permitted to retain his dignity. He even extended the feudal laws to them; and all bishops and abbots were obliged to furnish, during war, a number of knights, proportioned to the extent of the property possessed by each see or abbey.

William, as he had extinguished the very semblance of liberty among the English, now attempted to obliterate their name, by the destruction of their language. He ordered, that, in all the schools throughout the kingdom, the youth should be instructed in the French language. This was the language of the court, and of all fashionable company; and all laws and deeds were composed in that idiom. The English now saw themselves beyond the reach of deliverance: they were treated with every mark of insolence and indignity by their conquerors; and the plans of oppression which the king formed, were wantonly executed by his followers.

The two great earls, Morcar and Edwin, finding themselves despised, and without authority in the state, the only effort to make another effort to recover their independence. The former took shelter in the Isle of Ely with the brave Hereward, while Edwin proceeded to organize an insurrection in the north. But William frustrated their plans, by the capture of the Isle of Ely. He surrounded it with flat-bottomed boats, and compelled the rebels to surrender at discretion. Hereward alone forced his way through the enemy; and the king was so charmed with his bravery, that he received him into favour. Morcar was thrown into prison. Edwin, in attempting to escape into Scotland, was betrayed, and killed by a party of Normans; and many of the prisoners were punished with the loss of their hands or their eyes, and were dispersed throughout the country as monuments of the king's resentment.

A more formidable rebellion, however, soon followed. The Norman barons had also felt the arrogance of William's temper, and disgraced to stoop to his arbitrary authority. At the head of the discontent were the Earls of Hereford and Norfolk, and Waltheof, Earl of Northumberland, the only Englishman that retained any power in the kingdom. They perceived the opportunity of William's absence in Normandy, to throw off their allegiance, and entered into a secret correspondence with the king of Denmark, to assist them in their designs. Waltheof, however, who had married Judith, the king's niece, reflecting on the improbability of a successful overthrow of William's power, and fearing that, by changing one tyrant for many, it would be the means of increasing, rather than of alleviating the miseries of his countrymen, revealed the conspiracy to his wife. Judith had fixed her affections upon another, and viewing this as a favourable opportunity of getting rid of her husband, conveyed the intelligence, with every exaggeration, to her uncle. Waltheof, immediately after, passed over to Normanody, to inform William of every circumstance, and to make some atonement for his treason, by an early confession. His departure was no sooner known, than the conspirators flew to arms, before their plans were sufficiently matured, and before the promised assistance from Denmark had arrived. They were consequently soon suppressed; and the king, on his arrival, found order and tranquillity again restored. Many of the rebels were hanged; others were punished with the
loss of their eyes or hands; and Fitz-Aubert, a noble Norman, and Waltheof, the only two noblemen who suffered death on this occasion, were beheaded. The fief of Waltheof was greatly lamented by his countrymen; and it was supposed that he owed his death to the instigations of his wife.

When William first formed the design of invading England, he had, on the application of the French court, declared Robert, his eldest son, his successor in Normandy, and had obliged his barons to do him homage as their future prince; but after he found himself firmly established upon the English throne, he still retained the sovereignty of that duchy; and when Robert put him in mind of his promise, he positively refused to fulfill it. Robert inherited his father's military valour and was equally haughty and impatient of control. The denial of what he supposed his just right, kindled his indignation, which he had not the policy to conceal. He openly showed his discontent; and being further irritated by an imaginary affront, he left the court, and attempted to enforce his claims, by taking up arms against his father. He made an attempt to surprise the citadel of Rouen; but his design was frustrated by the vigilance of the garrison. He was fled to Hugh de Neufchateau, a powerful Norman baron, who assured him of his protection and assistance; and was soon after joined by most of the young nobility of Normandy and Maine. This unexpected and almost general insurrection of his Norman subjects, compelled William to have recourse to England. He assembled an army of Englishmen under the command of his ancient captains, and passing over into Normandy, soon re-established his authority in all his continental dominions. Robert, with the principal insurgents, shut himself up in the castle of Gerberoy, which the king of France had prepared for his reception, and where he was immediately besieged by his father. The garrison made a vigorous defence, and, conscious of their treason, were determined against submission. They harassed the besiegers by continual sallies; and many a bloody encounter took place under the walls of Gerberoy. In one of these, Robert and his father were opposed with the knowledge of others, their faces being concealed by their helmets; and being both charged with such fury, that William was dismounted. The arm of Robert was just lifted to strike, when it was arrested by the voice of his father. Stung with remorse for his unnatural conduct, he immediately fell on his knees, and implored his father's forgiveness. William, smarting under the disgrace of his fall, was at first inapplicable; but afterwards, reflecting on the generosity of his son, and influenced also by the mediation of the queen, he again received him into favour.

William employed the interval of peace in making a general survey of all the lands in the kingdom. He appointed commissioners for this purpose, who entered in their register, by the verdict of juries, the extent of lands in each district, their proprietors, their tenures, and their value; describing also the quantity of meadow pasture, wood, and arable land, which they contained; and in some counties, the number of tenants and peasants who lived upon them. This register was called Domesday Book, and is still preserved in the Exchequer. Had William always employed his leisure in such praise-worthy undertakings, it would have done honour to his memory; but he was generally occupied with other pursuits, which, while they ministered merely to his amusement, often brought poverty and wretchedness upon his unhappy subjects. His love of hunting, particularly, was carried to such a pitch, that, not content with the extensive forests which former kings possessed in all parts of England, he resolved to make a new one near Winchester, and for this purpose depopulated the county of Hampshire for an extent of thirty miles. The inhabitants were driven from their homes, their habitations demolished, and their property taken from them, without any compensation being made to the sufferers. The severest laws were also enacted against those who should hunt in the king's forests; and the killing of a deer or a boar was punished by the loss of the offender's eyes, while the crime of murder could be expiated by a moderate fine.

A.D. 1076.

The amusements of the king, however, were interrupted by the death of his consort Matilda, to whom he was tenderly attached; and about three years after he was called to Normandy, to repress the insolence and violence of some French barons, who had been encouraged by their sovereign to make inroads into his territories. In all the diversions in Normandy, the insurgents had been in general instigated, and secretly supported, by the French; and William knew well, that they were at best but insidious friends. He therefore resolved to make his vengeance fall upon those who were the real disturbers of his tranquility. His rage was on this occasion greatly heightened by the raileries of Philip, the French king. He had become very corpulent, and, being confined to bed by sickness, the Frenchman observed, that his brother of England was long in being delivered of his big belly. When William was informed of this, he sent Philip word, that he would soon be up, and that in churching would present such a number of lights at Notre Dame as would set all France in a flame. He accordingly took the field, and, entering the Isle of France, reduced the town of Mantes to ashes, and carried slaughter and desolation wherever he appeared. His progress, however, was stopped by an accident which put an end to his life. When leaping a ditch, the pommel of the saddle bruised his belly, which was soon followed by a mortification. On his deathbed, he endeavoured to atone for the many cruelties and acts of violence which he had committed upon his English subjects, by ordering Earl Morcar and the other English nobles to be set at liberty, and by making rich presents to churches and monasteries. He left Maine and Normandy to his eldest son Robert, England was bequeathed to William, and Henry was put in possession of the greatest part of his personal treasures. He died in the 63d year of his age, and 21st of his reign over England.

A.D. 1087.

William II., surnamed Rufus, from his red hair, immediately hastened to England, before intelligence of his father's death had reached that kingdom, and having secured the fortresses of Dover, Pevensey, and Hastings, and seized upon the royal treasure, he was crowned by Lanfranc the primate. His accession, however, was soon followed by conspiracies and dissensions. The barons were more attached to Robert, on account of his open and generous character, as well as his preferable title, being the eldest son. Many of them also possessed estates both in England and Normandy, and were unwilling that the two territories should be separated, as, in the event of a war, they would be obliged to resign either their ancient patrimony, or their new acquisitions. At the head of the discontented were Odo, Bishop of Bayeux, and Robert, Earl of Mortain, maternal brothers of the Conqueror, who, being joined by some of the most powerful noblemen in the kingdom,
and being encouraged by the expectation of success from Normandy, took possession of the fortresses of Pevensey and Rochester. The king, sensible of his brother’s superior claim to the kingdom, and of the strength of the conspirators, endeavoured to conciliate the English, by granting them liberty to hunt in the royal forests, and by general promises of lenity in his government. He was thus enabled to draw together a considerable army, and, entering Kent, compelled his uncles to surrender the fortresses which they had seized. The other rebels were soon reduced to submission, their estates were confiscated, and many of them banished the kingdom.

But William forgot, in his deliverance, the promises which he had made. Instead of ruling with lenity, and respecting the rights of his people, he became a greater tyrant than his father. Ambition and avarice were the principal features in his character. The English were now exposed to the most arbitrary exactions, and the church itself felt the effects of his oppression. He seized the temporalities of all vacant bishoprics and abbeys, and set up to sale such as he wished to dispose of. He even turned his eyes towards the duchy of Normandy, and having excited some of the Norman barons to revolt from his brother, he led a formidable army to their assistance. But the interception of the nobles on both sides brought about an accommodation, in which it was agreed, among other matters, that on the death of either without issue, the survivor should inherit all his dominions. Prince Henry, who had sided with Robert in this contest, finding his interests overlooked in the treaty, retired to St. Michael’s Mount, a strong fortress on the coast, and ravaged the surrounding country. He was there besieged by his brothers; and being obliged to capitulate, was despoiled of all his patrimony.

The interested and rapacious spirit of William, however, was continually exciting him to new acts of oppression. After a short and successful war with Malcolm, king of Scotland, in which his brother Robert commanded the English army, and obliged that monarch to do homage to the king of England, he again attempted the conquest of Normandy. He levied an army of 20,000 men, and, conducting them to the coast, as if for immediate embarkation, he demanded ten ships—a man in lieu of their services, and then dismissed them home. With this money he bribed the Norman barons to rebellion, and purchased the neutrality of the French king; but he was prevented from prosecuting his schemes of ambition by an interruption of the Welsh, which obliged him to return to England. He soon compelled them to retire, but was unable to follow them within their mountain barriers. His attempt upon Normandy was further suspended by another conspiracy, headed by Robert Moubray, earl of Northumberland, which contemplated the dethronement of the king, and the advancement to the throne of Stephen, count of Anjou, nephew to the Conqueror. Their plans, however, were discouraged by William’s dispatch, and Moubray was seized and thrown into prison, where he died.

The conquest of Normandy was still his favourite object; and the crusades, which now engrossed the attention of Europe, gave him quiet possession of those dominions which he could not obtain by force of arms. Duke Robert was brave, enterprising, and fond of military glory. He was anxious to join the warriors who were hastening to the Holy Land; and, in order to appear in a manner suited to his rank, he offered to mortgage his dukedom to his brother for 10,000 merks. William immediately accepted the proposal, and, little solicitous about the means by which the money was to be obtained, levied the greatest part of it upon the clergy and the convents, who were obliged to melt their plate in order to furnish the sum required. Robert was thus enabled to join the crusaders with a magnificent and numerous retinue; and Normandy was again united to the crown of England. This acquisition, however, instead of adding to the power of William, was followed by continual insurrections on the part of the Normans, who were always encouraged and supported by the French king; and was, indeed, the cause of all those wars between England and France, which afterwards continued, for whole centuries, to depopulate and weaken both nations. These insurrections, together with a quarrel which he had with Anschin, the primate, respecting the privileges of the clergy, kept William in almost constant inequity. Not content with the extent of his territories, he entered into an agreement with William, Earl of Poictiers and Duke of Guienne, who had also been infected with the enthusiasm of the age, to receive his dominions in mortgage, for a sum of money sufficient to conduct his vassals into Asia. But the fulfilment of it was prevented by his death.

When hunting in the new forest, attended by Walter Tyrril, a French gentleman remarkable for his skill in archery, a stag suddenly started before him, when his companion let fly an arrow, which, glancing from a tree, struck him to the heart. Tyrril, terrified at the accident, immediately fled to France, and joined a crusade of his countrymen who were then setting out for Jerusalem. The body of the king, when found by the country people, was buried at Winchester without either pomp or ceremony. His violence, rapacity, and prodigality, had estranged from him the affections of his subjects, and none were found to perform the funeral honours belonging to a king. He died in the 40th year of his age, and 13th of his reign.

Robert, who was the rightful heir to the crown, both by birthright and by the agreement with his deceased brother, was, after many a rough campaign in the Holy Land, indulging himself in ease and pleasure in the delicious climate of Italy, where he had married Sybilla, the daughter of an Italian count, when he received the intelligence of William’s death. He returned to Normandy about a month after that event, but found his brother Henry in possession of his crown.

Henry was hunting in the new forest when William met his death, and was no sooner informed of the circumstances, than he hastened to Winchester and secured the royal treasures. He then proceeded to London, where, assembling some noblemen and prelates whom he had gained over to his interest, he was solemnly crowned by Maurice, bishop of London. Henry, aware of the weakness of his pretensions, endeavoured to strengthen his authority, by curtailing the affections of his subjects. He confirmed the ancient Saxon laws, and restored the clergy to their former privileges. He promised to remedy many of the grievous oppressions which had existed during the two former reigns; and for this purpose passed a charter, in which, among other things, he engaged that he would never seize the revenues of any vacant see or abbey, or let to farm, or dispose of for any ecclesiastical benefice; that, instead of the violent exactions which had been imposed upon heirs by his father.
and brother, he would permit them to take quiet possession of their property, upon paying a just and lawful relief; that he would not dispose of any hearness in marriage, but by the advice of all the barons; that the barons should have the power of bequeathing, by will, their money and personal estates; and that all debts due to the crown should be remitted. A copy of this charter was commanded to be lodged in some abbey of each county, that all his subjects might be acquainted with it; but it was intended merely to serve his own ends, and to ingratiate himself with his people, and never to be seriously acted upon. In all his proceedings, indeed, he made his own will and pleasure the sole rule of his government; and this charter, within a century, had fallen into such neglect, that when the barons of King John wished to make it the model of the great charter, a copy of it could with difficulty be found.

Anselm, the primate, who had been obliged to leave the kingdom by the violence of William, was recalled by Henry, and reinstated in all his dignities. Henry knew well the influence which this prelate had acquired, by his piety and austerity of manners, over the minds of the people, and expected that his authority would be strengthened by having such a person for his friend. He found, however, that the religious zeal and stubborn integrity of Anselm, would not bend to his purposes; and scarcely had the prelate arrived, than a quarrel arose between them respecting the investitures in ecclesiastical benefices. The prelate refused to do homage for his spiritual dignity, and declared that he would not so much as communicate with any one who had paid such submission. Henry, for the present, did not press the demand, but sent messengers to Rome to accommodate matters with the pope. In the mean time, he married Matilda, daughter of Malcolm III. king of Scotland, and niece to Edgar Atheling. This circumstance added greatly to his popularity; and the English congratulated themselves with the hope of a more equal and mild administration, when the blood of their native princes should be mingled with that of their conquerors.

While Henry had thus endeavoured to establish himself on the throne, Robert appeared to assert his claim. On his return from the Holy Land, he had taken quiet possession of his ancient dukedom; and, being encouraged by many of the Norman barons in England, who promised him their assistance to recover the kingdom, he landed at Portsmouth with a considerable armament. Henry, by his caresses and promises, had gained over Anselm to his interests; who so exerted his influence with the nobility and the people, that the king was enabled to meet his brother with a firm and united army. The two sovereigns, both apprehensive of the issue, refrained from coming to action for some days; when, by the mediation of the primate, a treaty was entered into, by which Robert was to receive an annual pension of 3000 marks, upon resigning his claim to the crown of England during the life of Henry; and that, when either of them should die without issue, the other should succeed to his dominions. Henry was no sooner freed from the danger of invasion, than he began to wreak his vengeance upon those nobles who had distinguished themselves by their adherence to the cause of Robert; and scarcely one of them escaped without banishment or confiscation. It is true, they were prosecuted upon other charges; but men easily saw that their punishment arose from their attachment to his brother. Robert, considering such conduct an infringement of the treaty, ventured to appear in England, and remonstrate with Henry in person; but his reception was such, that he was glad to purchase his liberty with the loss of his pension.

Robert, with all his amiable qualities, wanted prudence and firmness. He was open, generous, and humane. His bravery and military glory had procured him the respect and admiration of Europe; and in peace he had filled a place of dignity and authority. He had long been accustomed to be born to be the sport of fortune. After a life of toil and ambition in the Holy Land, where he refused to be crowned king of Jerusalem, he found himself, on his return, deprived of his birth-right. Confined to his patrimonial dukedom, he was too mild to restrain, by severe discipline, the turbulent spirit of his barons, and Normandy, during his reign, became a scene of violence and depredation. His brother took advantage of his indolence and imprudence; and when called to mediate between him and his discontented subjects, instead of urging them to loyalty and obedience, he excited them to rebellion by bribery and intrigue; and at last stripped him of his kingdom and his liberty. In a battle, which decided the fate of Normandy, Robert and the most considerable of his barons were taken prisoners; and this unfortunate prince, deprived of fortune and friends, passed the remainder of his life a prisoner in Cardiff Castle in Wales, where he languished 20 years.

Edgar Atheling, who had accompanied Robert to Jerusalem, and had lived with him ever since his return, was also among the captives in this action; but Henry gave him his freedom and a small pension, and he lived to a good old age, neglected and forgotten among his countrymen.

Henry having now obtained the great point of his ambition, the sovereignty of Normandy, directed his attention to the settlement of his dispute with Anselm. The messengers who had been dispatched to Rome to confer with Pope Pascal II. on the right of the sovereign to confer ecclesiastical benefices, and to receive homage for them, returned with a positive refusal of the king's demands. Henry, however, was determined not to part with his rights so easily; and sent William de Warewelle to negotiate with his Holiness, and to attempt some means of accommodating the affair. During the conference, the English messenger told Pascal, that his master would rather lose his crown, than part with such a valuable privilege; "And I," replied Pascal, "would rather lose my head than allow him to retain it." Matters now grew serious, and the Pope threatened Henry with excommunication, unless he gave up the dispute. But the king still persevered in maintaining his rights; and by his prudence and abilities, at last brought the quarrel to an amicable compromise. He gave up the right of investiture, which consisted in bestowing upon the bishops a ring and crozier as the symbols of their office; and the pope allowed prelates to do homage for their temporal properties and privileges.

From this time, Henry was involved in almost continual war on account of Normandy. William, the son of Duke Robert, after the imprisonment of his father, had been entrusted to the care of Helie de St Saen, a nobleman of strict honour and integrity; and when Henry wished to recover possession of his person, Helie withdrew with his charge to the court of Anjou, and soon after obtained for him the countenance of Louis the Second, King of France. The war which was the consequence, was the cause of many heavy
and arbitrary taxes being imposed upon his English subjects, but was attended by no memorable event. Hostilities on both sides were carried on without energy or decision; and produced only slight and insubstantial skirmishes on the frontiers. Louis, however, finding that he could not prevail by force of arms, endeavoured to interest Pope Calixtus II, in favour of the young prince. He carried William to a general council which was held at Rheims, and represented to them the injustice of Henry in bereaving his nephew of his inheritance, and also of detaining in prison his brother Robert, who, on account of his eminent services against the infidels, was entitled to the protection of the holy see. But Henry employed a more powerful instrument to counteract the intentions of his enemies. He ordered his ambassadors to gain the pope and his favourites, with liberal presents and promises. The cause of William was consequently heard with coldness; and Calixtus, in an interview which he had with Henry, declared, that of all men he was, beyond comparison, the most eloquent and persuasive.

The war in Normandy was again renewed; but Henry being passed over with an army, gave the enemy battle at Breneville. During the conflict, Erquy, a Norman officer, who had followed the fortunes of young William, struck the King of England on the head with such force, that all his armour was covered with blood. Henry, however, no way intimidated, returned the blow, and continued the combat with such resolution, that he brought his antagonist to the ground. His troops were encouraged by his example, and victory declared for the English. A peace was soon after concluded between France and England, and the cause of William was forgotten.

Henry now seemed to have gained the summit of his wishes. Profound tranquility reigned throughout his extensive dominions, both at home and on the continent. He had secured the affections of his English subjects, by restraining the violence and oppression of his barons. These mutinous nobles were kept in awe by the vigour of his government, and his enemies were humbled and discouraged by his invariable good fortune. But an unforeseen misfortune blasted his fondest hopes, and darkened with sorrow the remainder of his days. This was the death of his only son, William, a youth of great promise, who had arrived at his 18th year, and who had been recognised as his successor, and had received the homage of the barons both of England and Normandy. When the king was returning from the latter country with a numerous retinue of the chief nobility, one of the vessels, in which was William and several young noblemen his companions, was carried on a rock, and almost immediately went to pieces. The young prince was put into the boat, and had left the ship, when the cries of his natural sister, the countess of Perche, recalled him to her assistance. Upon the return of the boat, the crew crowded into it in such numbers, that it went to the bottom, and all perished. A butcher of Rouen, who clung to the mast, and was taken up next morning by some fishermen, was the only person saved; and it is said that on this occasion, above a hundred and forty young noblemen of the principal families of England and Normandy were lost. When Henry heard of the disaster, he fainted away, and never laughed after.

The death of William left Henry without a male heir to his crown. His only surviving daughter Matilda, had been betrothed when only eight years of age, to the Emperor of Germany. But he dying without issue, she was afterwards united to Geoffrey of Plantagenet, the eldest son of Fulk, Count of Anjou. The king himself, in hopes of having male heirs, had been induced to marry Adelais, the daughter of the Duke of Lorraine, and the niece of Pope Calixtus. But this princess, who was of an amiable person, brought him no children; and Henry became apprehensive that his nephew William might eventually be enabled to recover the birth-right of his father. But the death of that prince, who was killed in a skirmish with the Langrave of Alsace, put an end to his fears; and his daughter Matilda, having been delivered of a son named Henry, he made the nobility take an oath of succession in her favour. Henry was in Normandy when this event happened, and found such satisfaction in the company of his favourite daughter, who bore successively two other sons, that he determined to spend the remainder of his days in that country. An irruption of the Welsh, however, recalled him to England; but as he was preparing for his journey, he was seized with a sudden illness, caused by eating lampreys, of which he died in the 67th year of his age, and 36th of his reign.

Henry, by his prudence, his talents, and his bravery, would have shone in whatever situation he might have been placed. His great progress in literature procured him the name of Beau-ecire, or the scholar; and his affability of manners encouraged and delighted all who approached his person. He seemed, however, to possess the prejudices of his family against the native English; and during his long reign, none of that nation were ever preferred to any ecclesiastical or civil dignity. Being a foreigner was a recommendation to his protection beyond what any Englishman was supposed to possess; and it was certainly no small evidence of the wisdom and moderation of his government, that the tranquillity of his English dominions was never once disturbed by those conspiracies and insurrections which were so frequent in former reigns.

The death of Henry was followed by many years of tyranny and misery to the defenceless inhabitants of England. This arose not from the character of his successor, but was the consequence of usurped power, which was necessitated to tolerate the violence and oppressions of the nobles by whom it was supported. The oaths of fealty which the barons had taken to Matilda, her son, were only remembered so long as the authority which imposed them was capable of enforcing obedience. These haughty chieftains had been growing in power, and exercised almost absolute dominion over those who held under them. They wished, therefore, for a monarch who should owe to them his exaltation, and who, on that account, would increase and confirm their privileges.

Stephen and Henry, the two youngest sons of the Count of Blois by Adela, daughter of William the Conqueror, had been bred at the court of England, and had received great honours and preferment. Henry had assumed the religious habit, and was created Bishop of Winchester; and Stephen had married the daughter and heiress of the Count of Boulogne, by which alliance he became connected with David, King of Scotland, who was his mother-in-law's brother. The late king had also bestowed upon Stephen rich and extensive possessions both in England and Normandy, for which he had always professed the greatest attachment and gratitude; and along with the other barons, had readily taken the oath of succession in favour of his cousin Matilda. But no sooner had his uncle breathed his last, than these favours, and his own professions, were forgot-
According to his last will, she would have been immediately received as queen. But her claim seems to have been little attended to, both in Normandy and England; and Stephen was scarcely crowned, when he was acknowledged in both kingdoms. Her brother Robert, however, who was a man of honour and abilities, was much attached to her interests, and waited only for a favourable opportunity to assert them. Robert possessed considerable influence in the kingdom, and was supported by numerous friends and retainers. On Stephen's accession to the throne, he had taken the oath of fealty; but with this express condition, that the king should never invade any of his rights or dignities; and thus he reserved for himself a pretence for throwing off his allegiance whenever he thought proper. As soon, therefore, as he had settled the plan of an insurrection, he retired to the continent, renounced his allegiance, and sent the king a defiance; upbraiding him with a breach of those conditions which had been annexed to his oath of allegiance. About the same time, the Scotch wars entered Yorkshire with an army in support of Matilda's claim; but the ravages and massacres which he committed, instead of drawing the nobility to his standard, enraged them against him. They assembled their vassals, and, awaiting his approach at Northallerton, defeated him with great slaughter; and David and his son Henry narrowly escaped falling into the hands of the conquerors. This success overawed the malcontents in England, and might have given stability to Stephen's throne, but he was not engaged in a quarrel with the clergy.

Sensible of the evils which attended the liberty of erecting so many castles throughout the kingdom, which only served as sanctuaries for treason and licentiousness, Stephen resolved to diminish their number, and for this purpose began by destroying those of the clergy. Many of the prelates had acted entirely as barons, and possessed fortified castles, and numerous retainers. Under pretence of a fray which had arisen in the court between the attendants of the Bishop of Salisbury and the Earl of Brittany, the king seized that prelate, and also his nephew, the Bishop of Lincoln, threw them into prison, and obliged them to deliver up the strong castles which they had erected. This bold measure at once excited the whole power of the church against him. Even the Bishop of Winchester, the king's brother, who had received a legati nuncio commission from the Pope, took part with his brethren, and resolved to vindicate their violated privileges. Stephen was sum-
arrived with an army to the relief of his friends. Stephen resolved immediately to give him battle. His troops consisted chiefly of foreign mercenaries, led on by tumultuous barons. After a violent onset, his horse gave way, and were soon followed by the infantry. The king, unaccustomed to fly, was left in the midst of the enemy. He defended himself with great bravery and resolution, till at last his battle-axe and sword being both shivered in pieces, he was compelled to surrender himself to the victors. He was thrown into prison at Gloucester, and loaded with irons.

Matilda is acknowledged as queen.

Matilda was immediately acknowledged as sovereign by most of the nobility and clergy; but she seemed to depend more upon the power of the latter, than of the barons, for the continuance of her authority. She determined to attach the Bishop of Winchester more firmly to her interests, by entrusting him with the entire administration of the government, and placing in his hands the disposal of all vacant bishoprics and abbeys. This unbounded power, accompanied with liberal promises, secured the favour of the legate and the church; and Matilda might have long reigned in tranquillity, had she possessed the policy and prudence to conciliate a turbulent and mortal people. But she disgraced the nation by her pride. She had been the wife of the emperor, and seemed still to retain a consciousness of her dignity. She knew not how to temper a refusal with affability; but rejected the petitions of her subjects in the most peremptory and haughty manner. She refused the petition of the Londoners, to replace the oppressive laws of King Henry by those of King Edward; and imprudently offended the legate, by denying his request to allow his nephew, Eustace, to inherit Boulogne, and Stephen's other patrimonial estates. This refusal was the cause of another revolution; and the prelates resolved to deprive her of a throne, to which she had been chiefly instrumental in raising her. He instigated the Londoners to revolt, and had nearly got possession of the queen's person. But she fled to Oxford, and afterwards to Winchester, where she was besieged by the legate. Being hard pressed by famine, she made her escape, but in the flight her brother Robert was taken prisoner. This nobleman was soon after exchanged for Stephen; and as each was the life of his own party, the contest was carried on for several years with great animosity, but without any decisive advantage on either side.

The death of Earl Robert, however, which happened in 1146, gave a severe blow to the interests of Matilda, and would have been fatal to her cause, had it not been counterbalanced by the imprudence of Stephen, who alienated the affections of many of his friends, by endeavouring to extort from them the surrender of their castles. About the same time, also, Eugenius III. had succeeded to the Papal throne, and had deprived Henry of the legantine commission, which he had conferred upon Theobald, Archbishop of Canterbury, his enemy and rival; and the king, by refusing to submit to some encroachments of that pontiff, was, with his whole party, laid under an interdict. These circumstances encouraged the adherents of Matilda; and Stephen was obliged to conciliate the church, by making proper submissions to the Pope. Both sides, however, were so weakened, that a cessation of hostilities was the consequence; and many of the nobility joined the crusade, which was at this time preached by St. Bernard. Matilda had retired to Normandy with her son Henry, to whom she soon after resigned the government of that duchy.

Young Henry Plantagenet had received the honour of knighthood from his grand-uncle David, King of Scotland; and, while in that country, had displayed such valour, gallantry, and prudence, as raised the hopes of his party in England. By the death of his father Geoffrey, in 1150, he succeeded to the duchies of Anjou and Maine; and by his marriage with Eleanor, daughter and heiress of William, Duke of Guienne, and Earl of Poitou, who had been divorced from Louis VII. King of France, he got possession of those rich provinces as his dowry. His power, added to his great accomplishments, had such an influence in England, that when Stephen was desirous of securing the crown to his son Eustace, and required Theobald, the legate, to assist him in his successor, that prelate refused, and immediately fled to the continent. This event prompted Henry to make an attempt upon England; and having gained some advantages over the royalists at Malmesbury, he proceeded to meet Stephen at Wallingford. But the chiefs of both parties dreading the renewal of bloodshed, compelled the rival princes to settle their differences by a compromise. A treaty was accordingly concluded, by which it was agreed, that Stephen should enjoy the crown of England during his life; that Henry should be acknowledged his successor; and that William, Stephen's second son Eustace being dead, should inherit Boulogne, and his patrimonial estates. Stephen survived this transaction only a year; and his death put his rival in quiet possession of the throne.

Henry II. on his accession to the throne of England, was the most powerful and the ablest sovereign in Europe. Besides his English and Norman dominions, he possessed in right of his father, Anjou, Touraine, and Maine; and in that of his wife, Guienne, Poitou, Anjou, Tongue, Perigord, Angoumois, and the Limousin. To these he soon after annexed Britanny, and the county of Nantz. He thus was master of above a third of the whole French monarchy, and consequently became an object of apprehension to the French king, who, though monarch of a rich and fertile territory, yet had so little control over his vassals, that they were accustomed to make war upon each other without his permission, and sometimes to turn their arms against their sovereign. Louis had remarked, with terror, the rising grandeur of the house of Plantagenet; and, in order to retard its progress, had always endeavoured to support the fortunes of Stephen. But he now saw that it would be in vain to attempt any opposition to Henry's succession, and considered it more prudent to conciliate, than to irritate, so formidable a neighbour.

The English, tired with bloodshed and depredations, and sensible of the noble qualities of their new monarch, received him with acclamations of joy, and all ranks willingly took the oath of allegiance. Conscious that his title to the throne was not only by hereditary right, but by the unanimous voice of the people, Henry began his reign, by resuming those privileges which had been extorted from the weakness of his predecessor. He restored authority to the laws, by demolishing all the castles which had been built since the death of Henry I., except a few which he retained in his own hands, for the protection of the kingdom. He dismissed the mercenary troops; revoked all the grants made by his predecessor; restored the coin, which had been much adulterated, during the former reign, to its proper value and standard; and, by a rigorous execution of justice, curbed the violence and robberies of the
feudal vassals. He gave charters to several towns, by which the citizens held their freedom and privileges from the sovereign himself; and thus, by enlarging the power of the people, he diminished that of the nobility, and was enabled to levy armies independent of the barons.

So far Henry's schemes of reformation were crowned with success; but when he attempted to repress the encroachments of the clergy, he found himself surrounded with difficulties, and involved in danger and disquietude. He had long cherished the design of putting a stop to clerical usurpations, and of maintaining the prerogatives of the crown; but the mild character, and advanced years of Theobald, Archbishop of Canterbury, prevented him from employing any active measures while that prelate lived. On his death, however, he resolved to exert himself, and, for this purpose, raised to the primacy his chancellor Thomas-a-Becket, on whose fidelity and compliance he thought he could entirely depend.

The clergy, during the former reign, had been advancing, with rapid strides, to independence; and such was the height which they had gained, that it was difficult to determine whether the king or the primate was the first man in the kingdom. They had extorted from Stephen new privileges, and immunities wholly inconsistent with the liberty of the subject, or the welfare of the kingdom. They had renounced all immediate subordination to the civil magistrate. They claimed exemption, not only from the usual taxes of the state, but also from its punishments, and pretended that ecclesiastical penalties alone could be inflicted on their offences. Lamentable crimes were the effects of these privileges, and murders, robberies, and rapes, were daily perpetrated with impunity by the lower orders of the church. No less than one hundred murders are said to have been committed, since the king's accession, by ecclesiastics; and holy orders were considered as a sufficient protection for every species of guilt. The first abuse, however, which Henry attempted to remedy, was the commutation of money for penances, which had been inflicted as an atonement for sins. To such an extent had this imposition grown, that more money was drawn from the people in that way, than was produced by all the funds and taxes in the kingdom; and to relieve his subjects, in some degree, from such a heavy and arbitrary burden, Henry required that a civil officer should, for the future, be present in all ecclesiastical courts, to give his consent in every case of a composition for spiritual offences. He next proceeded to the correction of more heinous irregularities, and he soon had an opportunity afforded him of exerting his abilities to the utmost. A clerk in the diocese of Sarum, having debauched a gentleman's daughter, afterwards murdered the father; for which crime he was tried in the archbishop's court, and was punished only with degradation. This circumstance had excited such general indignation, that the king commanded the murderer to be delivered up to the civil magistrate, to receive the punishment of the law. But Becket, who, since his exaltation to the primacy, had broken off all personal intercourse with Henry, and opposed him in all his plans of remedying clerical abuses, (see Becket,) insisted upon the privileges of their order. He asserted that no ecclesiastic could be punished with death; and even hinted to the king, that it did not become him to interfere in the affairs of the church.

Henry was not of a disposition to submit, either to insolence or injustice. He considered this case as a sufficient pretence for bringing, at once, to a decision, those controversies which were daily arising between the civil and ecclesiastical jurisdictions, and to define precisely what were the powers of the civil magistrate. For this purpose he convoked all the prelates of the realm, and demanded of them, whether or not they would submit to the ancient laws and customs of the kingdom: they replied, that they would, saving their own order. Henry, indignant at this evasion, left the assembly; and the bishops were so terrified by his threats, that they all complied except Becket, who, for a time, was inflexible, but who also was induced to yield at the request of the pope's legate.

The king then summoned a general council of the nobility and prelates, at Clarendon, to whom he submitted sixteen propositions, which were immediately agreed to, and which are well known under the title of the Constitutions of Clarendon. Among others, it was enacted, that all suits respecting the advowson and presentation of churches, should be determined in the civil courts; that clergymen, accused of any crime, should be tried by the temporal judges; that no person, particularly no bishop, should leave the kingdom, without the king's license; that no officer of the crown should be excommunicated or suspended, without the sovereign's consent; that no appeal should be carried to the holy see, except with the permission of the king; that all prelates should be regarded as barons of the realm, should possess the privileges, and be subject to the burdens imposed upon that rank; that goods forfeited to the king should not be protected in churches and church-yards; and that the sons of villeins should not receive holy orders, without the consent of their lord. To these, all the bishops, and even Becket himself, after some entreaty, set their seals, and also took an oath to observe the constitutions of Clarendon, legally, with good faith, and without fraud or reserve. The sanction of Pope Alexander III., would now have completed Henry's triumph; but that pontiff, perceiving the tendency of these laws to establish the independence of the civil power on the clergy, rejected them all but six, which were of the least importance, and which he was willing to ratify for the sake of peace. When Becket was informed of Alexander's decision, he expressed the deepest sorrow for his compliance; and even suspended himself from the exercise of all ecclesiastical functions, until he should receive absolution from the pope.

Henry, roused to indignation by the insolence and Henry's quarrels with Becket. Henry pro-obstancy of the primate, resolved to make him feel the weight of his vengeance. He desired the pope to grant a legantine commission to the Archbishop of York. This was sent, but a clause was annexed, forbidding him to execute any act in prejudice of the Archbishop of Canterbury. The king, disappointed in his purpose, returned the commission by the same messenger that brought it. He then instituted an action against him, for some lands which he held in his primacy. Becket excused himself for not appearing personally in court, on account of sickness, but sent four knights to plead his cause. This was construed into a disrespect for the king's court; and for this offence, the primate, in a great council held at Northampton, was punished with the confiscation of all his goods and chattels; and Henry, bishop of Winchester, was compelled, by order of the court, to pronounce the sentence against him. He was next day prosecuted for various small sums, which had passed between him and the king, which he was obliged to pay; and then, as it to crush him at once, Henry demanded of him to give an account of his ad-
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The king threatened with excommunication.

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administration while chancellor, and estimated his deficiencies, while in that office, at 40,000 marks. To answer such a demand, or even to find sureties for so great a sum, was impracticable. In this emergency, he was advised, by the Bishop of Winchester, to offer 2000 marks in lieu of all demands; but this was rejected by the King. Some exhorted him to resign his see, on condition of receiving an audience: whilst others thought that he should submit himself entirely to the king's mercy. But Becket saw that Henry was determined upon his ruin, which would only be hastened by submission, rejected these timid counsels, and resolved to brave the utmost efforts of royal indignation.

When the king and his court were assembled, the primate, arrayed in his sacred robes, proceeded to the palace, and taking the cross in his hand, as his protection from any violence, he entered the royal apartments. Henry, astonished at such unaccountable behaviour, sent some of the bishops to remonstrate with him on his conduct. But Becket was deaf to all persuasion. He put himself and his see under the protection of the supreme pontiff, and appealed to him against any sentence which the judges might give on the king's claim. He then left the palace, and having requested permission to leave Northampton, he was refused; but afterwards withdrawing in disguise, he escaped to Flanders.

In the prosecution of Becket, Henry seems to have been instigated more by a desire of revenge for his ingratitude and obstinacy, than by a regard to justice, or even prudence. Whatever were the primate's faults, the king certainly took the most effectual method of making these faults be forgotten. His violence and injustice opened the eyes of all men to the motives of his conduct, and Becket soon became the idol of the people, and was hailed by the clergy as a martyr in the cause of the church. He was received by the French king, and Alexander, with every mark of distinction. Louis was jealous of Henry's growing power, and the pope readily embraced a cause in which his own immediate interests were so deeply concerned, and assigned Becket the convent of Pontigny for his residence, where he lived for some years in great magnificence. Henry, in revenge, sequestered the revenues of Canterbury, and banished all the archbishop's domestic and relations. He also prohibited, under severe penalties, all appeals to the pope or primate, and declared it treason to bring from either of them an interdict upon the kingdom, punishable in seculars with the loss of eyes and castration, in regulars with amputation of their feet, and in laymen with death. These measures only tended to widen the breach. Becket had the spiritual thunders at his command, and, in revenge, communicated Henry's ministers by name, and absolved from their oath, all who had signed the constitutions of Clarendon. He even threatened the king with a similar punishment, and suspended it only to give time for submission. The pope acquiesced in all these proceedings, but was prevented from supporting the hostility of Becket, with greater determination, by the fear, that Henry would join the Emperor Frederic, who, at that time, supported the claims of an antipope; and as the means which had already been employed to bring the king of England to submission had not succeeded to his expectation, he had more to fear than hope from the continuance of the dispute. Henry, also, though he at first paid little regard to the fulminations of the Vatican, began to dread the effects which a sentence of excommunication might have upon his subjects, and became equally desirous of a reconciliation. Negotiations were accordingly entered into for this purpose, but were frequently broken off, by their mutual obstinacy and jealousy. At one conference, held in presence of the king of France and the French prelates, Henry said to that monarch, "There have been many kings of England, some of greater, some of less authority than myself. There have been also many archbishops of Canterbury, holy and good men, and entitled to every kind of respect. Let Becket but act towards me with the same submission, which the greatest of his predecessors have paid to the least of mine, and there shall be no controversy between us." This representation of the case made such an impression on the mind of Louis, that he withdrew his friendship from Becket; but his jealousy of the king of England soon led him to a renewal of it.

After many fruitless attempts, the controversy was at last amicably settled. It was agreed that the original dispute should be buried in oblivion; that Becket and his adherents should be restored to all their dignities and livings; and that those who had been promoted to benefices, dependent upon the see of Canterbury, during his absence, should be expelled. and the vacancies filled by the primate Henry, in return for these concessions, had only the satisfaction of seeing his ministers absolved from the sentence of excommunication, and himself relieved from the dread of a similar punishment. But he was anxious that tranquillity should be restored; and, in order to flatter the vanity of the prelate, even stooped, at one time, to hold his stirrup, while he mounted. This condescension on the monarch, however, was only additional fuel to the pride of Becket. Elated with the victory which he had gained over his sovereign, he determined to take advantage of his situation, and to repel every attempt of Henry to set bounds to the usurpations of the clergy.

The King, while the threatened sentence of excommunication was hanging over him, in order to secure the throne in his family, had associated with him his son Prince Henry in the royalty; and the ceremony of coronation was performed by Roger, Archbishop of York. This proceeding gave great offence to Becket, who pretended, that, as Archbishop of Canterbury, he had the sole right of officiating in such a ceremony. He therefore resolved to be revenge on the authors of this affront. The promise of Henry to have the ceremony renewed by the prelate, would not satisfy his vindictive disposition; and when on his arrival in England, he met Roger and the Bishops of London and Salisbury, who were on their way to join the king in Normandy, he intimated to the former the sentence of suspension, and to the two bishops that of excommunication, which at his instance had been passed upon them by the Pope. He was assured of support from Rome; and as he knew that his person and dignity were venerated by the people, he proceeded with the more courage to humble his enemies. He made a solemn progress through Kent, with all the splendour and magnificence of a sovereign pontiff. Wheresoever he passed, he was received with the shouts and acclamations of the populace; and men of all ranks celebrated his triumphal entrance into Southwark with hymns of joy. He then issued sentence of excommunication against some of the principal nobility, who had assisted at the young Prince's coronation, or who had been active in the persecution of the exiled clergy. This haughty and violent conduct was no sooner reported to Henry by the degraded prelates, who implored his protection from the vengeance of their oppressor, than he was so exas-
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In the mean time, Henry, with a view to divert the attention of his people from this subject, undertook the conquest of Ireland. He had received a grant of this country from his brother, Richard III, and subdued it with such rapidity, that in a few months he received the submission of the whole island: (See Ireland.) But he was recalled from this conquest by the arrival of the legates in Normandy, who had become impatient of his delay in appearing before them. At the first conference, he found their demands so exorbitant, that the negotiation was broken off; and as the time for taking advantage of Becket's murder was now past, they found themselves under the necessity of lowering their terms, when an accommodation was at last happily effected.

Henry having regained the favour of the church, and established tranquility throughout his extensive dominions, was regarded as the most powerful potentate of Europe. A numerous family gave lustre, and promised stability to his throne, and he looked forward to a peaceful and happy reign. But his happiness was short-lived. His eldest son, Henry, who had married Margaret, daughter of the French king, had been appointed his successor in the kingdom of England, the duchy of Normandy, and the counties of Anjou, Maine, and Touraine; Richard was invested in the duchy of Guienne, and county of Poictou; Geoffrey inherited the duchy of Brittany in right of his wife; and Ireland was destined for John. These arrangements were intended to prevent all jealousy among his sons, and perpetuate the greatness of his family. But he found his government disturbed, and his life imitated, by those very sons whose fortunes he had been so anxious to establish. Young Henry, who was brave, affable, but aspiring and ambitious, being instigated by the king of France, desired his father to resign to him the immediate possession either of England or Normandy. On his receiving a direct refusal, he fled to Louis, and prepared to enforce, by arms, what was denied to his request. He was soon after joined by his brothers Richard and Geoffrey, who had been incited to rebellion by their mother Queen Eleanor; and who had also demanded the government of those territories which had been assigned them. This unnatural combination was openly encouraged and supported by Louis, who engaged the chief vassals of his crown by oath to adhere to the cause of young Henry; and this prince in return bound himself never to desert his French allies. William king of Scotland, with the Counts of Flanders, Boulogne, Blois, and Eu, also entered into the confederacy, and a plan was projected for a general invasion of Henry's dominions. In this emergency, Henry at first recourse to the court of Rome, to reduce his unhappy children to obedience, and he proceeded from the Pope the excommunication of his enemies; but this produced very little effect, and he was at last compelled to take up arms in his own defence. His licentious barons, however, were in general in favour of the young Princes, whose government they knew would be less vigilant and severe than that of their father, and consequently many of them, particularly the Earls of Chester and Leicester, openly declared against their sovereign. Surrounded on every side by enemies, he sought assistance from the Brabançons, or Cottoreaux, a tribe of lawless banditti, who had long disturbed the tranquillity of the continental states by their depredations, and who professed their swords to those who would most freely pay them. With twenty thousand of these, and a few faithful nobles, Henry proceeded to the relief of Verneuil, which had been invested by the enemy. The garrison had engaged to capitulate, if not relieved within three days. On the third day the English army appeared in sight, when Louis, dreading an attack, insidiously demanded a conference, to settle the articles of a general peace. Henry readily consented; but Louis in the meanwhile obliged the garrison to surrender according to agreement, and, having set fire to the place, began to retire with his army. Henry, enraged at such treachery, fell upon the retreating army, and put them to the rout. He then crushed the insurgents in Brittany, and, while victorious, renewed the negotiations. At a conference with the king of France, held between Thie and Gisors, Henry beheld, with sorrow, his three sons in the picture of his enemy; but anxious to bring them to obedience, he proposed to them the most liberal terms. He insisted on retaining the sovereign authority in all his dominions, but offered to Henry half the revenues of England, with some places of surety in that kingdom; or, if he chose to reside in Normandy, half the revenues of that duchy, with all those of Anjou. To Richard, he made a similar offer in Guienne; and he promised to resign all Brittany in favour of Geoffrey. These advantageous offers, however, were rejected; and Henry was recalled to England by an invasion of the Scots.

William had entered Northumberland, and commis-
Henry's penance at Becket's tomb.

William, king of Scotland, defeated and taken prisoner.

A.D. 1175.

Henry being now freed from the toils of war, employed several years of peace in regulating the internal affairs of his kingdom. He made considerable alterations in the trial by water ordeal, which, though condemned by the church, still subsisted. He also moderated the trial by duel, allowing only either of the parties to challenge a trial, by a jury of twelve freeholders. He enacted severe penalties against murder, robbery, false coining, and fire-raising; and having partitioned the kingdom into four districts, he appointed a justice, who was either a prelate or a nobleman, to go the circuit in each division, and decide the causes in the counties. But he was interrupted in the execution of these wise measures, by new dissensions in his family. Philip, king of France, had succeeded his father, while only a youth of sixteen, and had been greatly indebted to the interference of Henry, in composing the quarrels which had arisen in the royal family of France on the death of Louis, and in establishing him upon the throne. But he required these services, by fomenting discord among the children of his benefactor. At this instance, young Henry renewed his demand of the cession of Normandy, and when refused, he found protection at the court of France. Philip, however, not being at that time disposed to support his pretensions, he made submissions to his father, and was reconciled. Richard also, who had received the duchy of Guienne, had refused to do homage for his dominions to young Henry, as he had been agreed upon, which occasioned a war between the two brothers. And this difference was scarcely settled between them, when the king discovered, that his eldest son was again engaged in a conspiracy against himself. His unnatural designs, however, were defeated by his death, which was occasioned by a fever in the 28th year of his age. Before he expired, he expressed great compunction for his unfaithful conduct, and earnestly entreated to see his father; that he might obtain his pardon. Henry, who had been deceived by the pretended repentance of his children, suspected that his sickness was feigned, and would not trust himself in his son's power. But when he heard of his death, he was affected with the deepest sorrow, and reproached himself with hard-heartedness, in refusing the dying request of his son. Young Henry dying without issue, Richard became heir to all his dominions; but not content with what belonged to his brother, he wished also to retain the duchy of Guienne, which Henry had intended for his youngest son John. He even proceeded to take up arms in support of his claim; but dreading an insurrection of the Gascons in favour of his mother, he returned to obedience. Geoffrey, who had been put in possession of Brittany, and who was the most vicious of Henry's children, being known among the people by the name of the Child of Perdition, next demanded that the county of Anjou should be annexed to his territories. This being refused, he prepared for war. But he was soon after killed in a tournament at Paris; and his son Arthur, who was born after his death, was invested in his dominions under the guardianship of his grandfather.

About this time, the attention of all was directed to the progress of the Infidels in Palestine. Saladin, King of Egypt, had spread his conquests over the East; and, through the treachery of the Count of Tripoli, who commanded the Christian army, had reduced Jerusalem, and had almost entirely subdued the kingdom of Antioch. This intelligence filled the Western Christians with sorrow and dismay; and every effort was made to excite the sovereigns of Europe to undertake another crusade for the recovery of the Holy Land. The Arch-bishop of Tyre having procured an interview with Philip and Henry near Gisors, gave such a pathetic description of the sufferings of their fellow Christians in Asia, that they mutually laid aside their animosity, and immediately took the cross. But Richard, pursuing the dictates of ambition rather than of nature, was again seduced from his duty by the King of France, who was still jealous of Henry's power. He entered into an alliance with Philip against his father; and when a negociation was proposed to accommodate their differences, Philip required that Richard should be crowned during the lifetime of Henry, should be invested in all his foreign dominions, and should immediately espouse Alice, Philip's sister, to whom he had formerly been affianced. These proposals were rejected by the king of England.
and open hostilities immediately commenced. As this contest put a stop to the projected crusade, the pope's legate in France excommunicated Richard as the principal cause of discord, and threatened to lay an interdict on Philip's dominions. But these proved entirely ineffectual to restrain the ambition of these princes; and they carried on the war with such vigour, that Henry, after having lost several towns, found himself under the necessity of submitting to very humiliating conditions. It was agreed that Richard should marry the Princess Alice, and should receive the homage and oath of fealty of all his father's subjects; that Henry should pay 20,000 marks to the King of France, to defray the charges of the war; that his own barons should promise, that in case of his violating the treaty, they would join Philip and Richard; and that an indemnity for the past should be offered to all. These terms, rigorous and mortifying as they were, did not affect him so much as the discovery that his favourite son John had been langued with his enemies. When he read his name in the list of those barons to whom he had engaged to grant a pardon for their connection with Richard, he was overwhelmed with grief. He cursed the day that he was born; and bestowed on his ungrateful and undutiful children a malediction, which he never pardoned, and which he always cherished. This last domestic affliction of the spirit, and brought on a lingering fever, of which he died at the castle of Chinon near Saumur, in the 53rd year of his age, and 53rd of his reign. This prince was equally distinguished by his private as well as his public virtues. His greatest blemish was his amour with the fair Rosamond, by whom he had two sons, Richard Longsword, and Geoffrey, afterwards Archbishop of York; and his hypocritical devotion at the shrine of Thomas-a-Becket cannot be justified, even by the emergency of his affairs at the time. By one weak action he cancelled the firmness of his past conduct, and rivetted upon his people those fetters of superstition which, during the former part of his life, he had been attempting to unbend. In his general conduct, however, he displayed the highest qualities of the understanding and the heart. He was the most tender and indulgent of fathers, and though his affections were often torn by the ingratitude and disobedience of his children, his temper always preserved its natural and sensitive path of the spirit, and in the execution of justice he was severe without oppression. In war he possessed bravery and conduct; and perhaps there never was a monarch who extended his dominions and authority so far, with so little violence and injustice.

Richard was no sooner informed of his father's death than he was stung with remorse for the undutiful part which he had acted, and professed his respect for his father's memory, by retaining Henry's ministers and servants in those offices which they had so honourably discharged to their former master; while those who had encouraged and assisted his rebellion, met with neglect and hatred. He immediately restored to liberty Queen Eleanor, who had been long detained in confinement; and profusely bestowed upon his brother John no less than six earldoms, with many opulent and extensive possessions. The commencement of his reign, however, was attended with a very melancholy catastrophe, which, while it shews the bigotry and superstition of the age, proves how ineffectual the authority of the sovereign was to restrain the violence of his subjects. Richard had prohibited any of the Jews from appearing at his coronation; but some of that nation, presuming upon the large presents which they had made to the king, ventured to approach the hall where he dined. As soon as they were discovered, they were exposed to the insults and outrages of the populace; and a rumour was widly spread, that the king had ordered the massacre of all the Jews within the kingdom. London was immediately filled with uproar. The houses of this defenceless people were pillaged and burnt, and they and their families put to death. The houses of wealthy Christians were also attacked and plundered; and so general was the spirit of riot and pillage, that when the king empowered Glanvil, the Justiciary, to inquire into the authors of this enormity, so many of the principal citizens were found to be involved in it, that it was deemed proper to drop the prosecution. At York there were similar disorders, and five hundred Jews, who had retired to the castle for safety, finding themselves unable to defend it against the assaults of the populace, murdered their wives and children, and threw the dead bodies over the walls upon the besiegers; they then set fire to the buildings, and perished in the flames.

This zeal against the enemies of the cross was the The king ruling passion of the times; and Richard, who to this prepares for his crusade, added a love of military glory, was scarcely seated upon his throne, when he began to prepare a crusade. Every other interest and consideration was sacrificed to the success of this pious enterprise. His father had left him above 100,000 marks, and he endeavoured to increase this sum by every expedient. The revenues and manors of the crown, and the offices of greatest trust and power in the kingdom, were exposed to sale. The dignity of chief justiciary was bought by the Bishop of Durham for 1000 marks; and the vassalage of Scotland, together with the fortresses of Berwick and Roxburgh, was sold for 10,000 marks. Exactions and extortion were next employed, and the oppression was felt by all ranks. He was at last enabled to proceed with a well-appointed army to the plains of Vezelay, where he had promised to meet the king of France. There the two monarchs reviewed their forces, and having sworn inviolable friendship, and publicly pledged their faith not to invade each other's dominions during the crusade, they departed for the Holy Land. See CRUSADES.

And set out for Palestine.
A. D. 1190.

Disorders during his absence.
commence hostilities against the dominions of Richard during his absence, yet he endeavoured by every mean secretly to annoy and distract his government. He even detached Prince John from his allegiance, by promising him his sister Alice in marriage, and offering to put him in possession of all his brothers' lands. But the trick was discovered in due time, and that vicious prince was prevented only by the authority of the queen-dowager, and the menaces of the council, from raising a civil war in the kingdom.

Richard was informed of all these machinations of his rival. The ardour of the crusaders had gradually abated; and their numbers being thinned by the sword, by fatigue, and by disease, they now thought of returning home. Richard alone opposed this desire; but he was at last obliged to yield to the general wish, and concluded a truce with Saladin for three years. On his way home, Richard was shipwrecked on the coast of Italy, and, having assumed the disguise of a pilgrim, attempted to pass secretly through Germany. His experiences and liberalties, however, betrayed the dignity of his character, and he was arrested at Vienna, by the Duke of Austria, to whom he had given some disgust at the siege of Acre. This prince delivered him up for a considerable sum to Henry VI., Emperor of Germany, who threw him into a dungeon, and loaded him with irons. This fatal intelligence filled his subjects with grief and consternation. He had secured their affection by his bravery and generosity; and the only traitor in the kingdom was his brother John, who secretly rejoiced in his imprisonment, and joined his influence to that of the king of France to continue his captivity. They entered into negotiations with the emperor to deliver his royal prisoner into the hands of Philip, or to detain him in perpetual confinement; and John, taking advantage of the general confusion, attempted, with the assistance of Philip, to wrest the sceptre from the hand of his unfortunate brother.

The English, however, notwithstanding all these ungenerous efforts, continued faithful to their king; and, when the emperor was at last compelled, by the remonstrances of the German princes, and the threatenings of the pope, to agree to his release for a large ransom, the sum was cheerfully raised by his subjects. One hundred thousand marks were immediately paid, and sixty-seven hostages were delivered for the payment of 50,000 more. Richard's arrival in England was hailed with the utmost exultation; and never did a nation testify such joy at the appearance of its monarch. His splendid victories, the dangers which he had passed, and the sufferings which he had undergone, endeared him to a martial and high-spirited people; and he found all ranks ready to assist him in taking vengeance on the authors of his misfortunes. As soon as he had settled his affairs in England, he hastened to oppose the invasion of Philip in Normandy; but no exploit worthy was recording was the consequence of this war. John deserted the cause of Philip, and implored the forgiveness of his brother. At the intercession of Queen Eleanor, the king forgot the baseness of his conduct, and generously received him into favour. The war with France was several times concluded and renewed, without any advantage being gained on either side. A treaty of peace was at last about to be concluded, by the mediation of the Pope's legate, when the death of Richard put an end to the negotiation. This prince, after a reign of ten years, passed almost in continual hostilities, received his death-wound when besieging one of his vassals in the castle of Chalus, near Limoges, in the 42d year of his age.

Richard possessed the highest military talents; and his intrepidity and personal bravery had acquired him the appellation of Cœur de Lion. With a disposition open, generous, and sincere, he was at the same time ambitious, haughty, and cruel; and had his reign been lengthened, the restlessness of his character would have detached him from the affectionate attachment of his neighbours, or would have led him, as he threatened, to undertake another expedition against the Infidels.

The accession of John to the throne was immediately followed by the revolt of the provinces of Anjou, Maine, and Touraine. They declared in favour of Arthur, the son of Prince Geoffrey, John's elder brother, though only a youth of twelve years of age; and were readily supported by the king of France, who embraced every opportunity of raising commotions in the rival kingdom. John, however, had Richard's will in his favour, and had been acknowledged by the barons of England and Normandy. He therefore prepared to maintain his claim by force of arms; and passing over into France, was enabled, by the assistance of the Earl of Flanders, to defend himself against all the efforts of his enemy. Constantia, the mother of Arthur, in the mean time, becoming jealous of the intriguing character of Philip, and suspecting that he intended to usurp the dominion of the revolted provinces, rather than preserve them for her son, secretly withdrew Arthur from his court, and put him into the hands of John, to whom he did homage for the duchy of Brittany, which he possessed in right of his father. This defection obliged Philip to give up the contest, and a treaty was soon after agreed upon, in which the limits of their territories were properly adjusted, and the interests of their vasals mutually secured. As a token of sincere reconciliation, John gave his niece Blanche of Castile in marriage to Louis, Philip's eldest son, and with her the baronies of Issoudun and Graen, and other fiefs in Berri.

John being now undisputed master of the kingdom, and thinking himself secure on the side of France, began to give reins to his passions, and to expose himself, by his tyranny and weakness, to the hatred and contempt of his subjects. Being deeply enmoured with Isabella, the daughter and heir of the Count of Angouleme, he was determined to possess her at every hazard. She was betrothed to the Count de la Marche, and had been consigned to the care of that nobleman; but John persuaded her father to carry her off from her husband; and having divorced his queen, he married her in spite of the menaces of the Pope, who exclaimed against such conduct. The Count de la Marche, and his brother the Count d'Eu, immediately took up arms, and exiled to insurrection the malcontents of Poictou and Normandy. The king demanded from his English barons a sufficient force to quell the rebels. But these chiefs had begun to feel the influence which they had in the kingdom, when under the government of a weak prince, and unanimously refused, unless he would promise to restore to them their ancient privileges. This was the first symptom of a regular association among the nobles, for curbing the power of the crown. But their plan was not sufficiently matured, and they were obliged to yield to the menaces of their sovereign. John at first overawed the insurgents by his superior arms, but he soon raised up new enemies by his arbitrary and imprudent conduct. It was the custom of those times, that the causes in the Lords Court were chiefly decided by duel; and he carried with him a set of bravos or hired ruffians, whom he intended should fight with his barons, when any controversy was to be decided between him and them. This gave offence to

Marriage of the king.

England.
War with France.

The Duke of Brittany, who had now arrived at man's estate, had also become distrustful of his uncle; and passing over into France, joined the army of Philip, by whom he was treated with great distinction, and received the hand of his daughter Mary.

The allies were everywhere victorious; and so rapid was the progress of their arms, that John was threatened with the loss of his continental possessions. They received a check, however, by the rashness of young Arthur, who, fond of military fame, had entered Poitou with a small army, and laid siege to Mirébeau, where his insurtert enemy Queen Eleanor then resided. John hastened by forced marches to her relief, and coming upon Arthur before he was aware, dispersed his forces and took him prisoner, together with the most considerable of the revolted barons. This good fortune revived for a time his sinking cause; but he soon exposed himself, by his cruelty, to greater danger and danger. Having repelled his nephew the folly of his pretensions, he endeavoured to withdraw him from the French alliance, and to bring him back to a sense of duty. But the young prince, amazed by the presence of his conqueror, boldly asserted his claim, not only to the French provinces, but also to the crown of England. The king finding it vain to reason the matter, determined to rid himself of a rival, by his death. Arthur was accordingly never more heard of; and though the circumstances of his murder were carefully concealed, yet it was universally believed that he fell by his uncle's own hand.

This inhuman deed excited general horror and detestation of the tyrant. The Bretons, enraged at the murder of their prince, laid their complaints before Philip, and demanded justice on his murderer. Philip summoned the king of England to trial, and, upon his non-appearance, adjudged him to forfeit all his fiefs in France. Vigorous efforts were immediately made to put the sentence into execution; and while the king of France was employed in reducing his fortresses, and extending his conquests over his dominions, John was amusing himself at Rouen. When informed of the success of the enemy, he boasted that he would retake in a day, what it had cost the French years to acquire. But notwithstanding his vaunts, Philip proceeded in his career, and laid siege to Chateau Gaillard, the strongest fortress on the frontiers of Normandy. This place was defended by Roger de Laci, a brave and determined officer, and a numerous garrison. For a twelvemonth they bravely repelled every assault; but being at last greatly reduced by famine and fatigue, they were overpowered and made prisoners of war. On the reduction of this bulwark, all Normandy lay open to his arms, and soon submitted to the conqueror. Anjou, Maine, Touraine, and part of Poitou, were also successively reduced; and John was expelled with disgrace from all his foreign dominions. On his arrival in England, he attempted to excuse the cowardice and folly of his conduct, by exclaiming against his barons, who, he pretended, had deserted his standard; and in order to regain his character, he collected a fleet, and summoned his vassals to attend him on a foreign expedition. But his design was several times deferred; and when he at last ventured abroad with a considerable army, he merely took and burnt the town of Angers, but fled on the approach of Philip, and returned to England, loaded with new shame and disgrace. Though despised for his cowardice, and hated for his cruelty, yet he still preserved the prerogatives of his crown; but new affronts awaited him, and having imprudently entered into a contest with the church, he was reduced to the most abject degradation.

On the death of Hubert, archbishop of Canterbury, a dispute arose respecting the election of a new primate. That important privilege belonged to the monks or canons of Christ Church; but some of the juniors of that order had met privately, and had chosen Reginald their sub-prior as Hubert's successor. As no election, however, could be considered as regular without a congé d'elire from the king, and as the suffragan bishops of Canterbury also claimed the right of concurrence in the choice of their primate, John ordered the monks to proceed to a new election, when the Bishop of Norwich was unanimously chosen. The dispute came before the Pope, Innocent III. who, glad of an opportunity of nominating to such a high office, declared both the elections null, and commanded the monks, under pain of excommunication, to choose for their primate Cardinal Langton, an Englishman, but attached to the see of Rome. This attempt to usurp one of the highest prerogatives of his crown, filled John with ungovernable fury. He vented his rage against the monks of Christ Church, whom he expelled from the convent; and when Innocent threatened to lay an interdict upon his kingdom, he swore that he would banish all the bishops and clergy of England, and confiscate their possessions. This idle violence and imprudence encouraged Innocent to persevere in bringing this weak prince to submission, and the interdict was accordingly pronounced. At once the churches were shut; the altars were despoiled of their ornaments; the bells were removed from the steeples; the dead were thrown into ditches, or buried in common fields without any funeral solemnity; marriages were solemnised in the churchyards; the people were forbidden to salute each other, or even to shave their beards; and every deprivation was enforced that was calculated to strike with awe the minds of a superstitious people. John, in revenge, banished the prelates, and confiscated the estates of all the clergy, who obeyed the interdict; but, instead of attempting to secure the interest, or gain the affections of the barons, who alone were able to defend him against these papal usurpations, he seems to have disdained all orders of men by his tyranny and licentiousness.

As John still continued obstinate, the Pope next proceeded to pass a sentence of excommunication against him. No sooner was this known, than many of the bishops and nobility left the kingdom, which so alarmed the king, that he proposed a conference with Langton at Dover, when he offered to receive him as primate, to restore the exiled clergy, and to pay a limited sum as a compensation for the rents of their confiscated estates. The cardinal, however, was not content with these terms, but demanded that full reparation should be made to all the clergy. This exorbitant demand put an end to the conference, and was soon after followed by another papal sentence more terrible than either. The subjects of John were absolved from their oath of fidelity and allegiance; all were declared excommunicated persons, who had any
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From the barons, was more inclined to favour the weak and submissive John, than these high-spirited nobles, who would embrace the first opportunity to wrest the kingdom from his dominion. He accordingly expressed his disapprobation at the conduct of the barons, but advised the king to grant such demands as were just and reasonable. At Easter the barons assembled at Stamford, attended by 2000 knights, and a considerable number of foot, and advancing to Brackley, where the court then resided, presented a schedule of their demands. The king rejected them with indignation, and the barons immediately proceeded to open war. They besieged the castle of Northampton, occupied Belford, and were received into the capital without opposition. They laid waste the king's parks and palaces, and threatened with their vengeance all the other barons who refused to join them. John finding himself almost completely deserted, was obliged to pretend compliance. He met his barons at Runneymede, between Windsor and Staines; and after a debate of a Magna few days, signed and sealed that famous deed, called Charta the Great Charter, which secured very important liberties and privileges to every order of men in the king- dom; and which is still regarded as the great bulwark of British freedom: (See Magna Charta.) In order to secure the execution of this deed, the city of Lon- don was retained by the barons, and the Tower was con- signed to the custody of the primates. They were also allowed to choose 25 of their own number as conserva- tors of the public liberties. When any of the articles of the charter were infringed, four of these might ad- monish the king to redress the grievance, and upon re- fusal, the council of 25, in conjunction with the great council, were empowered to compel him to observe the charter by force of arms. These men were, in fact, in- vested with the sovereign authority, and all the sub- jects were bound to swear obedience to them under the penalty of confiscation.

John acquiesced, through fear, in all these regula- tions; but he waited only a favourable season to re- tract every promise which he had made. He retired into the Isle of Wight, and, secluded from his courtiers and his nobles, meditated plans for the recovery of his authority. He complained to the Pope of the violence of the barons; and secretly enlisted into his service a numerous body of rapacious Brabançons. Inno- cent, enraged at the presumption of the barons in despising his mandate, issued a bull, in which he an- nulled and abrogated the whole charter; he prohib- ited the barons from exacting the observance of it, and the king from paying any regard to it; and excommuni- cated all who should persever in defending it. John, at the same time, let loose his mercenaries upon the defenceless inhabitants; and, as the barons, trusting to the security given them by charter, had disbanded their forces, he marched from Dover to Berwick without op- position, reducing, wherever he went, the castles and villages to ashes, and filling the whole kingdom with consternation and misery. The barons, in this extrem- ity, being unable to make head against their sovereign, offered the crown to Louis, the son of Philip, if he would protect them from the violence of the tyrant. Philip accepted their submission, and, regardless of the menace of the pope, sent over a small army to their assistance; and soon after Louis arrived and made up several forces. On the appearance of Louis, many of John's foreign troops deserted to the enemy, but both armies committed the most wanton ravages. The French advanced to London, where Louis was solemn-

commerce with him, either in public or in private; and he himself was deposed from his throne, which was offered to the king of France. Philip eagerly embraced the offer, and shewed, by his preparations, how desirous he was to succeed. He collected a fleet of 1700 sail in the ports of Normandy and Picardy, and having summed all the vassals of the crown to attend him, he was in a short time ready to make a descent upon Eng- land. John, though hated and feared by all, was en- abled to advance to Dover at the head of 60,000 men; for the English, however much disposed to submit in matters of religion, would not yield their independence to any tribunal; and had their monarch possessed wisdom and resolution to take advantage of their spirit, and of the natural enmity which subsisted between the two nations, he might have retrieved his situation, and broken for ever the power of the clergy within his dominions. But every thing was to be feared from his cowardice and incapacity. Instead of braving the storm, he bartered his kingdom for his safety; and at a conference with Pandulf, the Pope's legate, he yielded his crown, whereby to the distraction of his dominion. Inno- cent was satisfied with his submission, and commanded Philip to desist from his enterprise. John was now made to feel the insolence of papal power. He was re- quired to resign his kingdom into the hands of the Pope; and to hold it as feudatory of the church of Rome, by the annual tribute of a thousand marks. He then did homage to Pandulf as the Pope's representa- tive: he came disarm'd into his presence, flung himself on his knees before him, and swore fealty. By this abject submission he secured his crown; but he was degraded in the eyes of his people. He next received his barons, and demanded the revenues of his predecessors, particularly those of king Edward, and to maintain justice and right in all his dominions.

John, being now restored to the favour of the church, thought himself secure of tranquillity; and continued to exercise his authority with the most overbearing in- solence and oppression; but he was only reserved for further misfortunes, and still greater degradation. The barons had entered into a confederacy for the restoration of their ancient privileges. They were encouraged and supported in their design by the archbishop of Canterbury, who, being of a generous and liberal spirit, was anxious to promote the real interests of the king- dom. At a numerous meeting of the barons summoned by him at St Edmondsbury, under pretence of devotion, he produced an old charter of Henry I. of which he exhorted them to demand the renewal and observance; and represented in such strong colours the arbitrary conduct of their sovereign, that they all swore before the high altar to support each other, and to make end- less war upon the king, till he should grant their dem- ands. They accordingly assembled in London on an appointed day, and preferred their requests to the king, which were to renew the charter of Henry, and confirm the laws of King Edward. John required some delay to consider of their demands, and promised that he would give them a final answer at the festival of Easter. In the mean time he endeavoured to engage the Pope in his favour, and to draw the clergy to his side by new concessions. But in this case, the interests of the clergy were some measure involved with those of the barons; and the king soon found, that he had to contend against the united strength of these two power- ful bodies. Innocent, who had received also an appli-
ly crowned, and received the homage of the barons and burghers. But the partiality of the new monarch to his own countrymen, and a report, that he had threatened to exterminate the English barons as traitors to their prince, and bestow their estates and dignities on his native subjects, were very prejudicial to his cause. This report was universally credited; and the information was said to have been derived from the Viscount Melun, one of Louis’ courtiers, who revealed it to some of his friends on his death-bed. The Earl of Salisbury, and many other noblemen, jealous of the French influence, returned to their allegiance to John, who was advancing with a considerable army to make one mighty effort for his crown; and the French had every reason to dread a reverse of fortune. But as the king was passing from Lynn, along the sea-shore, and being ignorant of the situation of the place, he lost all his carriages, treasure, and baggage, by the influx of the tide. He was so overwhelmed with grief at this disaster, and the distracted state of his affairs, that he was seized with a fever, which soon after put a period to his existence, in the 49th year of his age, and 18th of his reign.

The character of this prince has been justly held up to general reprobation, as including almost every vice that was mean and odious in our nature; but while we despise his cowardice and detest his baseness, we ought to remember, that it was to his weakness and incapacity, more than to the firmness and generosity of the barons, that we are indebted for the foundation of the British constitution.

The death of John was fatal to the cause of Louis. The resentment of the barons against their sovereign was buried with him in the grave; and the youth of his son Henry, who succeeded him, claimed their pity, rather than enmity. At the head of the opposite party also, was the Earl of Pembroke, an experienced and disinterested statesman, who had maintained, during the whole contest, his fidelity to John unshaken, and who was determined to support, at every hazard, the interests of his son. That nobleman, in a general council of the barons, was chosen protector of the realm; and having crowned the young king at Gloucester, in the presence of Guiso, thelegate, he endeavoured to reconcile all ranks to the government of Henry, by new concessions. The Great Charter, with some alterations and additions, was renewed and confirmed; and new cities were brought near to its present shape; and these concessions were so acceptable to the people, that Louis soon found himself almost without an adherent. The discontented barons hastened to make their submission, to prevent those attainders to which they were exposed by their rebellion; and his cause was rendered still more desperate, by the defeat of his troops near Lincoln, and the destruction of the French fleet, which carried a considerable reinforcement, off the coast of Kent, by Philip d’Albiny, the English commander. He was consequently glad to conclude a peace upon any honourable terms; and stipulated only for his own safety, and an indemnity to his adherents.

The death of the Protector, which happened soon after this accommodation, threw the kingdom into new combinations. It required all the wisdom and valour of that virtuous nobleman, to restrain a licentious and powerful nobility; and though his successor, Hubert de Burgh, possessed both abilities and integrity, he was unable to suppress that spirit of insubordination among the barons, which is the usual attendant of a minority. They held by force the royal castles, and usurped the king’s demesnes. They were continually surrounded by a disorderly retinue, whom they encouraged and protected, in all their outrages and depredations; and the people, as well as the king, suffered by their oppressions. The Earl of Albemarle was particularly distinguished for his violent and illegal proceedings; and Hubert, in order to reduce him to obedience, seized upon Rockingham castle, which he had garrisoned with his adherents. This drove him to more open rebellion; but being excommunicated by Pandulph, the legate, he was deserted by his associates, and obliged to sue for mercy, when he was again restored to his possessions. This restless chief, however, continued for some time to give disturbance to the government. When Henry was declared by the pope to be of full age, and the barons were required to resign into his hands the royal castles and fortresses, Albemarle and some others openly refused. They even attempted to surprise London, and seize the person of the king; and such was the weakness of the executive, that they were considered too formidable to be punished. They were at last, however, through fear of excommunication, forced to comply.

As Henry advanced to man’s estate, he showed himself totally unfit for the government of the kingdom in its present unsettled state. He was gentle and humane, but without activity and vigour; and so fickle and irresolute, that men neither valued his friendship nor dreaded his resentment. Had he been steady to the course of Hubert de Burgh, he might have prolonged and subdued the resentment of his barons; but this able and virtuous minister was displaced, in a fit of caprice, and exposed to the persecution of his enemies. His successor, Peter des Roches, bishop of Winchester, was of a very different character, and by his arbitrary and violent conduct, raised new divisions in the state. He was a Poitevin by birth, and advised the king to invite over a number of his countrymen and other foreigners, whom he pretended could more safely be trusted than his English subjects. Upon these men every place of command and preferment was bestowed to the exclusion of the natives, which occasioned such general discontent, that a combination was formed by the barons to expel the king’s minister from his office. They withdrew from parliament; and when again summoned to attend, they demanded that Henry should dismiss his foreigners, otherwise they would drive him and them out of the kingdom, and put the crown upon a head more worthy to wear it. Peter des Roches, however, found means of disconcerting their schemes. He began to pass laws in favor of the barons, and dispossessed the foreigners, and the more obnoxious barons had their estates confiscated, without legal sentence or trial by peers; and their possessions were profoundly bestowed upon the Poitevins. Edmond, the primate, at last interfered, and threatened the king with excommunication, unless he would dismiss his minister and his associates. Henry was obliged to submit; but the barons found it was only a change of masters. The king having married Eleanor, daughter of the Count of Provence, the kingdom was again inundated with strangers, who were caressed, enriched, and loaded with preferment. The more obnoxious barons had their estates confiscated, without legal sentence or trial by peers; and their possessions were profusely bestowed upon the Poitevins. Edmond, the primate, at last interfered, and threatened the king with excommunication, unless he would dismiss his minister and his associates. Henry was obliged to submit; but the barons found it was only a change of masters. The king having married Eleanor, daughter of the Count of Provence, the kingdom was again inundated with strangers, who were caressed, enriched, and loaded with preferment.

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barons; and when complaints were made against their oppressions and violations of the law, they scurried not to deny, "What did the English law signify to them?"

The discontent of the nation was heightened by the failure of the king's expeditions to the continent. In a war with Louis IX., he lost what remained to him of Poictou, and involved himself and his nobility in an enormous debt. But even these grievances of the civil government were less burthensome than the usurpations and exactions of the see of Rome, which the king never failed to countenance and support. Besides the tenth of all ecclesiastical living, the Pope, by his legates, wrested large sums from the prelates and convents. He exacted the revenues of all vacant benefices; he claimed the goods of all interstate clergymen, and levied benevolences upon the people. He filled the chief benefices of the kingdom with Italians, who are said to have possessed, during this reign, living in England to the annual amount of 60,000 marks, and carried his usurpation to such a height, as to claim a right to all ecclesiastical property, which he could dispose of at his pleasure. He next endeavoured to embark Henry in a war with Sicily, in which he himself was engaged; and offered the crown of that kingdom to his brother Richard, who had been created Earl of Cornwall; and who, having amassed immense wealth, would be able to support him in his military operations. Upon the refusal of Richard to enter into such a scheme, it was offered to the king for his second son Edmond, upon the single condition that he would defray the expenses of the conquest. Henry, dazzled by such a present, inconsiderately agreed to the proposal, and gave his Holiness unlimited credit to expend whatever sums were necessary for completing the enterprise. By this foolish bargain, he found himself, before he was aware, involved in a debt of 135,000 marks. In this emergency, he applied to the Parliament, but they unanimously refused to lend their assistance to such a project. The clergy were now his only resource; and, with the aid of the legate, he extorted from them 150,000 marks. This sum, however, was still insufficient. New demands were made by the Pope, and interdicts and excommunications were threatened in case of non-compliance. Henry at last began to discover the cheat, and resigned his claim to a crown, which he could never expect to enjoy.

About the same time, the Earl of Cornwall engaged in an enterprise equally vain and vexatious. On the death of the Emperor Frederic, he was tempted to become a candidate for the Imperial throne. After expending large sums, he was chosen king of the Romans; and proceeding to Germany, he attracted, by his liberality, numerous friends and partizans. But he was soon drained of his wealth by the avidity of the German princes, and returned to England, ashamed of having lavished the savings of a whole life upon the acquisition of an empty dignity.

The barons still continued resolute in refusing supplies, and every application of Henry was met on the part of the parliament with a remonstrance against the oppressions of his favourites, and his violations of the great charter. He at last pretended, that he had taken the vow of a crusade, and demanded their assistance. At this time he made the most humble submissions, and promised a redress of all ecclesiastical and civil grievances. But they had so often experienced the deceitfulness of his submission and promises, that they at first hesitated to comply; but at last consented to grant him a tenth of the ecclesiastical benefices, and a scutage of three marks on each knight's fee, upon condi-

- tion that he would ratify the great charter in a more solemn manner than had hitherto been employed. On this occasion, the prelates and abbots were assembled, each with a burning taper in his hand. The charter was read before them, and sentence of excommunication was denounced against all who should violate it. They then threw their tapers on the ground, and exclaimed—

"May the soul of every one who incurs this sentence so stink and corrupt in hell! To which the king subjoined—"So help me God, I will keep all these articles inviolate, as I am a man, as I am a Christian, as I am a knight, and as I am a king, crowned and anointed."

But Henry, still weak and inconstant, soon forgot his oath; and, again swayed by the counsels of his favourites, returned to his usual extortions and oppressions. Complaints against his government were loud and general. The barons, fatigued with fruitless submissions, and seeing no prospect of obtaining redress at the hands of the king, entered into a confederacy to seize the reins of the state, and compel the fulfilment of those promises which they had so long looked for, but in vain. At the head of this confederacy was Simon de Montfort, Earl of Leicester, a foreigner by birth, but who had succeeded to a large inheritance in England. By insinuation and address, he had acquired a strong interest in the nation, and had gained the affections of all ranks; and being of a violent and ambitious temper, he was capable of the most daring designs. He had alternately experienced the favour and hatred of Henry; but being at last disgraced and banished from court, he resolved to attempt an innovation in the government, and wrest the sceptre from the feeble hands of his sovereign. This spirit of hostility first appeared when Henry had summoned a parliament, in expectation of supplies for the Sicilian war. The barons came to the hall completely armed; and in this hostile attitude expostulated with the king on his imprudent and illegal conduct. That though he had often acknowledged his errors, and promised to give satisfaction to the nation, yet he had still allowed himself to be carried into the same measures; that he must therefore dismiss these faithless counsellors, and confer authority upon those who were more ready and able to redress the public grievances. The king yielded to their demand, and summoned another parliament at Oxford, to prepare such regulations as might be deemed necessary for the reformation of the state. On the day appointed, the barons appeared at Oxford at the head of their vassals; and that assembly, afterwards known by the name of the Model Parliament, appointed 24 commissioners, to whom were entrusted the reformation of abuses. Of these, 12 were chosen from the king's ministers, and 12 from the barons; and the king took an oath, that he would adhere to whatever regulations they should adopt for the welfare of the nation. At the head of this council was Leicester, who directed all their deliberations; and they first ordered that four knights should be elected by each county, to report at next meeting of parliament the grievances which were most felt in their neighbourhood. They then enacted that there should be three sessions of parliament every year; that a sheriff should be annually elected by the votes of the freeholders in each county; that no wards or castles should be entrusted to foreigners; and that no new warrens or forests should be made, nor the revenues of any county or hundred be let to farm. These were the only regulations of the council, from which the public could
derive any advantage. Their future conduct betrayed their selfish and ambitious views; and the object of all their subsequent measures seems to have been, the continuance of their authority, and the aggrandizement of themselves and families. They deposed all the chief officers of the crown, and filled their places with their own creatures. They assumed the custody of all the castles; and even imposed an oath upon all the lieges, that they would execute and obey all the ordinances of the 24 barons. Even Prince Edward, the king's eldest son, and the king of the Romans, after some opposition, were compelled to take this oath. They bound themselves also to stand by each other with their lives and fortunes; and during the interval of the sessions, the whole authority of parliament was vested in a committee of twelve.

These proceedings opened the eyes of the nation to their selfish intentions; and as they had prolonged their authority from time to time, under the pretence that their task was not yet brought to a conclusion, the people became apprehensive that they wished to establish their own power upon the ruins of the royal prerogative, and called loudly for a termination to their intended regulations. The knights of the shires, who seem to have assembled in a separate house, also remonstrated against the slowness of their proceedings; and appealed to Prince Edward to interpose in behalf of the nation. Edward sent a message to the barons, requiring them to hasten the conclusion of their undertaking; as he was determined to resist their usurpations at the hazard of his life. The popular voice was now on the side of the king. The barons had enjoyed the sovereign power nearly three years; but, instead of employing it for the good of the nation, they had openly abused it to the promotion of their own interests. Jealousies and animosities had also crept into the council; and the defection of the Earl of Gloucester, whose moderation ill suited with Leicester's ambitious projects, revived Henry's hopes of regaining his lost power. Leicester, enraged at the opposition he met with even from his own party, had retired to France in disgust.

The barons being thus in a manner disinherited and deprived of their leader, the king took advantage of their quarrels; and having received from the Pope absolution from his oaths and engagements, he resumed his authority. He removed all the officers appointed by the barons; placed new governors in the castles; summoned a new parliament; and offered to refer all the differences between him and the Earl of Leicester to the mediation of Margaret, Queen of France. That bold and turbulent nobleman, however, rejected all interference of a foreign court; and trusting to his influence over the barons, and the unsettled state of Henry's government, meditated an insurrection for the recovery of his power. He had even enticed over to his party Gilbert, the young Earl of Gloucester, and Henry d'Almaine, the son of the King of the Romans; and having entered into a confederacy with the Welsh, who had made an insurrection in England with 30,000 men, he secretly came over from France, and commenced an open rebellion. He was favoured and supported by the Londoners, who broke out into open sedition, and committed the most horrible excesses. He had also seized the person of Prince Edward, who was the very soul of the royal cause; and had assumed such an imposing attitude, that the king was glad to submit to an accommodation. By this treaty, the barons were again reinstated in the sovereignty of the kingdom; and, at a parliament held at Westminster, they insisted that their authority should continue during the lives both of Henry and Edward. These ignominious terms were submitted to by the king, but were rejected by his son, who exerted himself with such success in the defence of his rights, that he prevailed upon many, who had adhered to the barons, to join the royal cause.

Hostilities were again renewed; but the universal clamour of the people for peace was so strong, that both sides agreed to submit the dispute to the arbitration of Louis IX. This prince, instead of availing himself of the distractions of a rival state, to advance his own authority, or to extend his dominions, had, during the whole struggle, acted with the greatest moderation and integrity. Whenever he interposed in the affairs of England, it was with the sincere intention of composing the differences between the king and his nobility, and he always recommended to both parties every peaceable and conciliatory measure. When appealed to by both parties, he declared the impartial and honourable dictates of his mind. He annulled the provisions of Oxford, and re-established the royal authority as it stood before the meeting of the mad parliament; he confirmed the people in all the privileges and liberties which they enjoyed by any former concessions or charters of the crown; and ordered a general amnesty to be granted for all past offences. Though Leicester and his associates had sworn to abide by the award of the French monarch, yet they determined to reject this equitable sentence, and to procure by arms more advantageous terms. The country again became the theatre of a civil war. The king and prince assembled their vassals, and prepared for defence. They were reinforced by some of the bravest barons of the north; and the first advantages were in their favour. Northampton was carried by assault; and Leicester and Nottingham opened their gates at their approach. The rebels, however, were in possession of London, and had laid siege to Rochester. The royalists hastened to its relief, and Leicester fell back upon the capital. But being strongly reinforced, he determined to give battle to the king. The armies met near Lewes, in the county of Sussex. The battle was begun by Prince Edward, by attacking with great fury the Londoners, who composed the van of the rebel army. He drove them off the field with great slaughter; but while he was eagerly pursuing the advantage which he had gained, his father and uncle were defeated by Leicester, and taken prisoners. The prince attempted to retrieve the fortune of the day; but his followers were intimidated, and he was obliged to submit to Leicester's terms. The rebel demanded that the prince and Henry d'Almaine should surrender themselves as pledges in place of the two kings; that all the other prisoners should be set at liberty; and that the final agreement should be settled under the direction of the King of France.

Leicester had no sooner got the royal family into his power, than he forgot his agreement with Edward. He still detained the king as a prisoner, and assumed the sole direction of affairs in the kingdom. He engrossed to himself the ransom of all the prisoners; and seized on the estates of eighteen barons as his share of the spoil in the battle of Lewes. He even treated his confederates with the most wanton insolence; and protected the pirates of the cinque-ports upon condition of receiving a third of their prizes. Knowing that this usurpation of authority could not continue.
without opposition, he endeavoured to increase his popularity, and strengthen his power, by admitting into a share of the government an order of men, which had been hitherto regarded as unworthy of a voice in the councils of the nation. He summoned a new parliament at London; and, besides its usual members, he ordered returns to be made of two knights from each shire, and of deputies from the boroughs. This was the first embryo of the House of Commons,—an institution which, in process of time, proved one of the most useful and powerful members of the British constitution, and which gradually rescued the kingdom from aristocratical, as well as from regal tyranny.

Leicester continued to act in the most arbitrary manner; and, trusting to his popularity, procured to himself all rival to the Earl of among the baronians. He seized the Earl of Derby, whom he threw into prison, and obliged others to leave the kingdom. The Earl of Gloucester even began to dread his authority, and retired to his estates on the borders of Wales. These dissensions revived the hopes of the royalists; and they were farther encouraged by the general wish of the nation for the liberation of the young prince, which Leicester found himself compelled to gratify. That nobleman, however, stipulated for the delivery of all the royal castles, and that the prince should neither leave the kingdom, nor introduce any foreign forces into it during three years. This treaty was of very little advantage to Edward, who, though declared free by the barons, found himself surrounded by the emissaries of Leicester. He at last, however, contrived, by the assistance of Gloucester, to make his escape; which was no sooner known than the royalists flew to arms, and, being joined by many of the discontented barons, presented an opposition, which Leicester was unable to withstand. He had followed the Earl of Gloucester with his army into Hereford; and here he found himself surrounded by his enemies. Edward had cut off all communication with his friends, by destroying the bridges on the Severn; and had also surprised and dispersed an army under his son. Simon de Mountfort, which was hastening to his relief. Ignorant of his son's fate, Leicester had crossed the river in boats, and encamped at Evesham, in expectation of reinforcements. Here he was attacked by Edward, at the head of the royalists, who were inspired by their recent victory. The rebels, who had been weakened by sickness and desertion, defended themselves with great bravery; but at last gave way on all sides, and were pursued with immense slaughter. Leicester, with his eldest son Henry, and about 100 knights, fell in the action. The old king, who had been placed in the front of the rebel army, was wounded, and in great danger of being killed; but, when the blow was falling upon him, he cried out, "I am Henry of Winchester, your king. Saviour." On the slightest show of recrudescence, he was carried to a place of safety. By this decisive victory, Edward at once quelled a rebellion which had lasted for several years, and which had threatened to extirpate his family, and to extinguish the prerogatives of the crown. The rebellion, however, had been so extensive, that the king, on resuming his authority, found it necessary to exercise it with clemency and moderation. No blood was shed on the scaffold; and the only attainders that were fully carried into execution, were those of the Mountfort family.

The Earl of Gloucester, to whom Edward was greatly indebted for the recovery of his liberty and the success of his cause, considering his services undervalued, attempted to renew the flames of rebellion, and excited the Londoners to take up arms. This insurrection was soon suppressed by the activity of the prince; and Gloucester was pardoned, and received into favour, upon his entering into a bond of 20,000 marks, to keep the peace. Edward, however, to relieve himself from all apprehension of disquiet from the formidable power and turbulent disposition of this nobleman, determined to carry him along with him to the Holy Land, whither he had promised to accompany the king of France.

While Edward was reviving among the Saracens the glory of the English name, his father was unable to protect his subjects from the power of the barons, who renewed their oppressions; and committed continual ravages throughout the kingdom. Worn out with age, the feeble Henry could ill manage a sceptre, which in his best days had been wrested from him by a turbulent nobility. After the departure of his son, his health visibly declined, and he expired at St. Edmondsbury, in the 64th year of his age, and 56th of his reign.

Edward had reached Sicily on his return home, when Edward I. he heard of his father's death. His succession, however, being undisputed, and the council having appointed a powerful regency during his absence, he was in no hurry to take possession of his crown, but spent a year in France. He arrived in England after an absence of about three years, and was crowned at Westminster amidst the joyful acclamations of his people.

A prince like Edward, who had already gained the affections of his subjects, and possessed abilities and courage, might easily have extended the prerogatives of the crown as they were enjoyed by his most warlike predecessors; but he was contented with more moderate authority, and set himself to the correction of abuses in the government, and in guarding against those civil commotions which had been so frequent during the reign of his predecessor. His first step was to free the prisoners of the barons, by a strict and impartial administration of justice: He appointed commissioners to inquire into disorders and crimes of all kinds, and rigorously to inflict the punishment of the laws: These were distinct from the ordinary judges, and were confined to the western counties of England, where bands of banditti had become so numerous and powerful as to set all law at defiance. The terror, however, which the severity of the commissioners excited, soon put a stop to their depredations. The corruption of the judges themselves was a more serious evil; and to such an extent did it prevail, that when they were brought to trial before parliament, all of them, except two, who were clergymen, were deposed and severely fined. The king afterwards compelled all the new judges to take an oath that they would receive no bribes.

The Jews were the greatest sufferers in this general renovation of the laws; and as they were hated both by the prince and the people, they were often condemned to death for the slightest information. In London alone, 250 of them were hanged for adulterating the coin; many of the Jews of them had their lands and goods sold and confiscated; and Edward, prompted by his zeal against infidelity, or rather by his rapacity, at last banished them the kingdom, and despoiled them of all their property, except what was sufficient to bear their charges to foreign countries. Having regulated the internal affairs of the kingdom in a manner which promised security to himself and to his people, Edward turned his views to the conquest of Wales.

The Welsh were the only remains of the ancient Britons that had preserved, among their inaccessible mountains, their laws and customs uncontaminated by foreign invasion. Bearing a hereditary enmity against the English, who enjoyed the rich possessions from
which they had been expelled; they seized every opportunity of laying waste their country. They endeavoured to profit by every disturbance among their enemies; and had been deeply engaged in the rebellion of Leicester. Lewellyn, Prince of Wales, on the suppression of that rebellion, had been included in the general accommodation; but dreading the resentment of Edward, he still carried on a secret correspondence with the Mountfort faction, and had even paid his addresses to Leicester's daughter. The discovery of this correspondence furnished Edward with a pretext for war. He marched a numerous army into Wales, and having hemmed in the enemy among the hills of Snowdon, reduced them to submission by famine. Lewellyn and all his barons swore fealty to the crown of England. This humiliation, however, was but of short duration. The Welsh, irritated by the insults and oppressions of their haughty victors, again flew to arms: But it was the signal for their ruin. Edward, well pleased with an opportunity of again going to war, resolved to free himself from all future apprehension of disturbance from that quarter, by making an absolute conquest of the country. He assembled all his military tenants, and entered Wales with an army which rendered resistance vain. Lewellyn was surprized and killed. His brother and successor, David, was driven from one retreat to another, and at last betrayed to the enemy. This prince was tried by Edward as a traitor, and was unjustly ordered to be executed. The Welsh nobility immediately submitted, and the principality received the laws of England. But the barbarous policy of Edward led him to a more inhuman step even than the unjust murder of their sovereign. Sensible how much traditional poetry and music is calculated to keep alive the idea of national valour and glory, he assembled together all the Welsh bards, and ordered them to be put to death.

During an interval of three years of peace, the king resided chiefly on the continent, whither he had been called to accommodate a dispute between the kings of Aragon and France respecting the kingdom of Sicily. On his return, he found his attention arrested by the state of affairs in Scotland. Alexander III. had died without male issue, and had left his kingdom to his grand-daughter Margaret, who was yet an infant. This princess was the daughter of Eric, king of Norway, and Margaret, daughter of Alexander, and is commonly known in history under the name of the Maid of Norway. On the death of her grandmother, she was immediately recognized as sovereign by the states of Scotland, and a regency was appointed to administer the affairs of the kingdom during her minority. Edward, whose mind was continually alive to projects of ambition, was no sooner informed of Alexander's death, than he conceived the design of uniting the whole island into one monarchy, by the marriage of the Maid of Norway with his eldest son Edward. The proposals of the King of England were accepted and approved of by the Scottish parliament, who even agreed that their young sovereign should be educated at the court of Edward. But these flattering prospects were soon dissipated by the death of the young princess, who died on her passage to Scotland. The disputes and disorders which were the consequences of her death, still furnished Edward with a pretext for interfering in the affairs of the neighbouring kingdom; and of at least endeavouring to compel, by force of arms, what he had been prevented from accomplishing in an amicable manner. But these transactions, in which he was chiefly engaged during the remainder of his reign, will be particularly detailed under the article SCOTLAND.

While Edward was intent on the conquest of Scotland, he found himself at the same time embroiled in a war with France. The origin of this war was a quarrel between an English and Norman sailor at Bayonne, in which the Norman was killed. The crew of the Norman vessel to which the deceased sailor belonged, complained to the king of France; but he, without inquiring into the business, bade them revenge themselves, and gave him no more trouble. They accordingly seized an English ship in the channel, and, having hanged several of the crew at the yard-arm, along with some dogs, dismissed the vessel, saying, That was the satisfaction they required for the blood of their countryman slain at Bayonne. This outrage and insult produced retaliations on the ships of France; and, in a short time, the whole navy of both nations were engaged in the quarrel. The sovereigns seemed to take no notice of the depredations which were daily committed against their respective subjects, until, the two fleets having met, an obstinate battle ensued, in which the French were totally routed, with the loss of 15,000 men. The affair had now become too serious to be overlooked; and Philip dispatched an envoy to England to demand reparation. Edward attempted to condescend; and, as he was apprehensive of danger from Scotland, he studiously avoided a rupture with France. Philip pretended, that as it was his honour merely that was interested by the outrages of the Gastons, if Edward would give him possession of Guienne, he would consider himself satisfied, and would immediately restore it. The king was deceived by the artifice, and ordered Guienne to be delivered to Philip, and no sooner got possession, than he threw off the mask, and declared himself sovereign of the province. Edward, enraged more at being thus over-reached, than at the loss of his territory, dispatched a considerable force for its recovery. All his attempts, however, were unsuccessful; and he was, in return, threatened with invasion from France. Philip had entered into a secret treaty with Bariol, king of Scotland; and had even made a descent upon the Kentish coast. His troops took and burnt the town of Dover, but were soon after compelled to retire.

The expenses attending his multiplied wars, obliged Edward to have frequent recourse to parliamentary supplies, and was the means of again introducing the lower orders into a share of the government. The parliament at this time consisted entirely of the great barons and the knights of the shires; for the representatives from the boroughs had never been summoned since the usurpation of Leicester. But as the growth of commerce, and the improvements in agriculture, had given property and consequence to the inhabitants of the towns, they were also called upon to contribute to the support of the state. The king, by his prerogative, had the power of taxing them at pleasure; but he sometimes found it both difficult and inconvenient in enforcing his demands: the taxes could only be levied with the consent of each particular borough; and this consent was often obtained only by solicitations or threatenings. To remedy, therefore, this inconvenience, Edward resolved to summon two deputies from each borough, who should be provided with sufficient powers from their constituents to agree to what he should require of them: "As it is a most equitable rule," said he, "that what concerns all, should be approved of by all; and common dangers be repelled by united efforts."
Above fifty years after, these deputies and the knights of the shires were united in one assembly, with the same rights and privileges, and now constitute the third estate of the realm.

Having procured a liberal supply from his parliament, Edward determined to prosecute the war, both in France and Scotland. He overran the latter kingdom with a numerous army, received the submission of the nobles, and carried Baliol a prisoner with him to London. He sent an army of 7000 men into Guienne, under his brother Edmund; but this prince soon after dying, the command devolved on the Earl of Lincoln, who terminated the campaign without any material advantage. Not discouraged by this failure, he prepared to make a more powerful effort for the recovery of the ancient patrimony of his family. He entered into an alliance with the Earls of Holland and Flanders, and flattered himself that, at the head of the allied forces, he might penetrate to Paris, and compel Philip to purchase peace by the restoration of Guienne. Considerable supplies, however, were requisite for the accomplishment of his plan; and he obtained from the barons and knights a grant of a twelfth of all their moveables; and from the boroughs an eighth. He also applied to the clergy for a fifth of their moveables; but here he met with an opposition, which put a stop, for a time, to his projected expedition.

Pope Boniface VIII had issued a bull, prohibiting any tax being levied upon the clergy without his consent; and the Archbishop of Canterbury told Edward, that they owed obedience to their spiritual, in preference to their temporal sovereign. "If you refuse, then," said the king, "to support the civil government, you are unworthy to receive any benefit from it;" and orders were immediately issued to all the judges, to do every man justice against the clergy, and to do them justice against nobody. Being thus put out of the protection of the laws, they found themselves at the mercy of every ruffian who chose to insult, to plunder, or even to maim them; and they were at last glad to submit to the king's demands, that they might be again admitted under the king's protection.

These supplies, however, were still insufficient for Edward's necessities; and he was obliged to have recourse to arbitrary measures, to complete his preparations. He carried off grain, and cattle, and other commodities necessary for supplying his army, wherever he could find them; for which he merely gave his promise of after-payment: and, in order to recruit his forces, he demanded the attendance of every man possessed of land worth £20 a-year. These oppressive exactions spread general discontent. The barons, jealous of the royal prerogative, and afraid of their own privileges, encouraged the complaints of the people; and, when Edward ordered the Earls of Hereford and Norfolk, the constable and marshall of England, to take the command of the forces to be employed in Gascony, these noblemen both refused, affirming that they were only bound by their office to attend his person in the wars. The king, in a rage, exclaimed to Hereford, the constable, "Sir Earl, by God, you shall either go or hang!"—"By God, Sir King," replied the constable, "I will neither go nor hang!" The king found it prudent not to press the matter; and consequently withdrew the expedition against Guienne: but he soon after embarked, with an army of 50,000 men, for Flanders.

The two ears had gained a strong party among the barons; and, when summoned to attend the parliament, in the king's absence, they came with a large force, and took possession of the capital. They proceeded, however, with moderation. They laid their demands before the council, and only required that the two charters should receive a solemn confirmation: that a clause should be annexed, to secure the nation against all imposition of taxes, without the consent of parliament; and that they and their adherents should be again received into favour. The charters were sent to the king in Flanders, who hesitated for a time to give his consent; but the dangerous consequences of a refusal being represented to him, he at last reluctantly complied. Some time after his return, he gave a more willing and absolute confirmation of the Great Charter, which so completely established its validity, that it was never afterwards formally disputed.

The war in Flanders was carried on with various success. Philip had taken Lisle, St Omer, Courtray, and Ypres; but his career was stopped by the appearance of the English, and his resources being exhaustcd, he had reason to apprehend great famine. Edward, however, had been disappointed of promised assistance from the king of the Romans, whom he had highly subsidised, and was equally desirous of concluding the war. Under the mediation of Boniface, the twonarchies at last came to an accommodation, in which they were both influenced by the most selfish policy. Edward abandoned his ally, the Earl of Flanders; while Philip did the same with the king of Scotland, who was still a prisoner in England; and, by these mutual sacrifices, they were left at liberty to prosecute their particular conquests.

A revolt of the Scots hastened the return of Edward. That unhappy people, under the brave Wallace, struggled for a time with the overwhelming power of England; and, though again subdued, and deprived of their leader, yet they seized the first opportunity of again rising against their oppressors; and, led on by Robert the Bruce, proceeded with a slow but certain step towards the recovery of their independence (Scotland). Edward, enraged at their frequent revolts, assembled an immense force; and was hastening to execute the most dreadful vengeance upon a nation, which had caused him so much trouble and anxiety; when he was suddenly taken ill at Carlisle, and died in the 36th year of his reign, and 69th of his age.

The abilities of this prince shone with equal lustre in the cabinet as in the field. The many wise statutes which he enacted, obtained for him the appellation of the English Justinian; and the improvements which he made in the execution of the laws, gave security and protection to the lowest orders of the people. But, while he took care that his subjects should do justice to each other, he was little solicitous about the rectitude of his own proceedings; and his arbitrary and violent temper, often led him into measures which excited the murmurs of the nation, and sometimes brought them to the very brink of rebellion. But his prudence in stopping in the moment of danger, and his compassion for the innocent, prevented any considerable disturbance during his reign. He tempered the severity of his disposition by the affability of his manners; and few princes have been more revered and respected by their subjects. The conquest of Scotland, which he considered as the greatest enterprise of his life, he left as a legacy to his son, whom he charged, with his last breath, to prosecute the war, and never to desist till he had annexed that kingdom to his dominions.
Edward II, came to the throne with the prepossessions of all ranks in his favour; and, had he possessed but a moderate share of prudence and abilities, he might have preserved inviolate the prerogatives of his crown, and have maintained a respectable name among the sovereigns of his time. But the weakness of his understanding, and the indolence and mildness of his disposition, rendered him totally incapable of wielding the sceptre over a turbulent and high-spirited people. Regardless of the dying commands of his father, he consoled the war in Scotland, disbanded his army, and gave himself up to pleasure and amusement. He recalled from exile his favourite Gaveston, who had formerly ministered to his youthful extravagancies. This Gaveston was the son of a Gascon knight, and had early insinuated himself into the affections of young Edward. He possessed an elegant person, and agreeable manners; but he was vicious and effeminate; and the late king, apprehensive of the ascendency which he had gained over his son, banished him the kingdom, and made the young prince promise never to recall him. Early possibilities L Lancaster, to soon found him in possession of the throne, than he sent for his favourite, and immediately distinguished himself with the highest marks of confidence and friendship. He endowed him with the whole erldom of Cornwall; gave him his own niece in marriage; and seemed happy only as he was enabled to load him with new honours and possessions. But the mind of Gaveston was ill fitted to bear with equanimity the full sunshine of royal favour. Naturally vain-glorious, his pride rose with his fortunes; and he took pleasure in displaying his power and influence, to the mortification of his rivals.

Marriage of the king.

While Edward was in France, espousing the princess Isabella, Gaveston was left guardian of the realm, with more ample powers than had usually been conferred; but, instead of gaining a party in his favour to support his sudden exaltation, he disgusted all ranks by his prodigality and pomp. The haughty nobles could ill brook the neglect of a weak monarch, and the domination of an insolent stranger; and a combination was accordingly formed to expel Gaveston from the kingdom.

At the head of this combination was the Earl of Lancaster, a prince of the blood, and one of the most potent barons in England; and it was also encouraged by the queen, who hated the favourite on account of his ascendency over her husband. The barons, when united, were irresistible. They came to the parliament with an armed retinue, and demanded the banishment of the favourite. Edward was obliged to submit, and immediately dispatched Gaveston to be lord-lieutenant of Ireland.

Unhappy in the absence of his favourite, whose company alone seemed to give him pleasure, the king tried every method of procuring his recall. He softened the opposition of Lancaster, and some of the principal nobility, by raising them to high offices in the government, or by loading them with civilities and promises, and then invited Gaveston to return. The favourite, however, instead of profiting by his past misfortunes, and henceforth enjoying his honours with modesty and moderation, heightened the general discontent, by new insults and injuries. The barons again took up arms, and compelled the timid Edward to devolve the whole authority of the kingdom on twelve commissioners. Their power was to continue only for one year; but whatever ordinances they should think proper to enact, were for ever to have the force of laws. Among other useful regulations, they banished Gaveston for ever from the kingdom, under the penalty of being declared a public enemy, in case of disobedience. The favourite retired to Flanders, but Edward was insupportable for his loss; and removing to York, where he thought himself secure from his enemies, he again recalled him. The barons now saw that the death of Gaveston was the only safeguard against their own ruin. Lancaster hastened to York; but the king had fled with his favourite to Scarborough, and having left him there, with a strong garrison, returned to oppose Lancaster. Scarborough, however, soon after surrendered to the rebels, and the unhappy favourite was put to death without even the form of a trial. The news of Gaveston's murder filled Edward with grief and indignation; and he threatened his utmost vengeance against all who had been concerned in that bloody transaction. But forgetting his feelings in his fears for his own safety, he agreed to an accommodation; and, as the barons were sufficiently satisfied with their revenge, they offered to ask his pardon publicly on their knees, when a general amnesty was immediately subscribed. Tranquillity and union being again restored, the attention of Edward was called to the progress of the Scottish patriots. Ashamed of his former inactivity, and of having allowed the favourable moment to escape, he now determined to execute his father's dying command. He collected, from all quarters, his most warlike vassals, and marched, with an immense army, to the frontiers of Scotland, with the certain hope of finishing, at one blow, the important enterprise which the first Edward had so successfully begun. But the decisive battle of Bannockburn drove him with disgrace from his expected conquest, secured the independence of Scotland, and fixed Robert Bruce upon the throne of that kingdom.

The Scots now retaliated upon their oppressors, and made many successful inroads into England. These disasters, with Edward's inflatuated attachment to favourites, again excited discontent among the barons, and kindled a civil war in the kingdom. Hugh Spencer, the new favourite, was of a noble family, and possessed all those exterior accomplishments which were fitted to make a favourable impression on the weak mind of the king. But he was equally destitute, with Gaveston, of prudence and moderation. He exceeded him in avarice, injustice, and prodigality, and soon became an object of greater hatred than even that unfortunate stranger. The turbulent Lancaster, at the head of the malcontents, entered London with an armed force, and compelled the parliament to pass a sentence of attainder against Spencer and his father. In this, Edward was obliged to acquiesce; but it was only with the intention of reversing it as soon as he had an opportunity; and this opportunity soon arrived.

The queen, who had long been joined by the barons in their hatred against the favourites, while on a pilgrimage to Canterbury, had been denied a night's lodging, by Badlesmere, governor of the castle of Leeds. Irritated by this affront, she persuaded her husband to take vengeance on his insolent vassal. Edward immediately raised an army, and having taken the castle of Leeds, put the governor to death. Being now emboldened with success, he resolved to take advantage of his situation, and to re-establish and confirm his authority, by the destruction of his enemies. He recalled the two Spencers from exile; and marched with his army to the marches of Wales, where the discontented barons chiefly resided. The Earls of Hereford and Lancaster endeavoured to oppose his passage of the Trent; but
A.D. 1326.

A difference having arisen between Edward and Charles the Fair, king of France, respecting the duchy of Guinevere, Isabella was permitted to go over to Paris, in order to adjust matters with her brother. Charles, however, required that the king of England should appear in his court, and do homage for that duchy; but as there were many obstacles to such a journey, the queen proposed that Guinevere should be given to young Edward, and that the prince should come to Paris and do homage to his superior lord. The king, glad of indulging in his indulgence, and in the society of his favourite, willingly consented. The queen, having now got the young prince into her power, was resolved to employ his influence for her own aggrandizement. She had fixed her affections, which had been long estranged from her husband, upon Roger Mortimer, a powerful baron, who, having been engaged in the late rebellion, had escaped into France. At the French court also she met with many English fugitives, the remains of the Lancastrian faction, who were ready to countenance any of her schemes that were likely to be the means of restoring them to their possessions and their country. Being thus supported, and having gained over the Earls of Kent and Norfolk, brothers to the king, as also the Earl of Leicester, brother and heir to Lancaster, and the Archbishop of Canterbury, with many other noblemen and prelates, she landed on the coast of Suffolk, with 8000 foreign troops. She openly declared that her only object was the expulsion of the Spencers from power; but with the ruin of the favourites, she meditated also the dethronement of her husband. As the Spencers were universally hated, the people soon flocked to her standard, and even Robert de Watteville, who was sent by the king to oppose her, joined her with all his forces. Edward endeavoured to rouse the citizens of London in his defence, but in vain; and being in a manner deserted, he fled towards Bristol. Thither he was pursued by the Earl of Kent, and the foreign mercenaries. He then passed over into Wales, leaving the castle of Bristol to the charge of the elder Spencer, who had lately been created Earl of Winchester; but he was by no means there, for the garrison mutinied, and delivered up their governor to the rebellious barons. This venerable nobleman, now in his ninetieth year, was condemned without trial, was hanged upon a gibbet, had his body cut to pieces and thrown to the dogs, and his head sent to Winchester to be exposed to the derision of the populace. His son soon after shared the same fate. The king, disappointed of the expected succours, had attempted to escape into Ireland, but, being driven back by a storm, he fell into the hands of the rebels, and was committed to the castle of Kenilworth, under the custody of the Earl of Leicester. The queen then summoned a parliament at Westminster, in which the king was charged with incapacity for government, and neglecting the public welfare. He was consequently deposed, and was soon after compelled, by menaces, to sign his own resignation. The young prince was then crowned king; but the whole authority of the government fell into the hands of his mother, and her paramour Mortimer. Not content, however, with imprisoning her husband, and her own exaltation, the queen endeavoured to hasten his death, by the most ignominious and cruel treatment. Her criminal correspondence with Mortimer had become apparent to all; and as they became hated for their vices, the dethroned monarch was regarded with pity and veneration. They did not consider themselves as safe while the king lived. He was sent from prison to prison, and made the sport of his mercenary keepers. Every mean was tried to break his spirit. He was kept totally destitute of all the comforts, and almost of the necessities of life. At one time they ordered him to be shaved, in the open fields, with cold and dirty water from a neighbouring ditch; when they refused to change it, he burst into tears, bending low his face, he exclaimed, that, in spite of their cruelty, he should be shaved with clean and warm water. But sorrow and affliction were instruments of murder too tardy for the impatience of his enemies; and Mortimer sent secret orders to his keepers to have him instantly dispatched. The assassins seized him while in bed, and, in order to prevent any outward marks of violence appearing on his person, they held him down with a table which they flung over him, and thrust a pipe up his body, through which they inserted a red hot iron, which consumed his bowels. His agonizing shrieks, and murdered,
Edward, having now taken the sceptre into his own hands, began his reign by correcting the disorders and suppressing the numerous gangs of robbers, which had increased to an alarming degree during the convulsions of the former reign, and the lawless administration of Mortimer. He then directed his attention to Scotland, which was again involved in a civil war by the death of Robert I. and the pretensions of Edward Baliol to the crown. David Bruce was only seven years of age when his father died; and he was soon after deprived of his able guardian, Randolph, Earl of Murray. The loss of this noble warrior and statesman would have been a serious blow to the kingdom of Scots in the present distracted state of the kingdom; it was a death-blow to the cause which he supported; and Baliol, by the assistance of Edward, was raised to the throne. His reign, however, was but of short continuance. His tame subjection to England excited the general indignation of the Scots; and Edward, with all his power, found himself unable to subdue the spirit of that warlike people. But his attention was soon drawn off to more important conquests.

Phllip the Fair left three sons, Louis Hutin, Philip the Long, and Charles the Fair, who were all successively kings of France, but who all died without leaving any male heirs; and one daughter, Isabella Queen of England. On the death of Charles, the male succession to the throne devolved upon Philip de Valois, Charles's cousin-german. Edward, however, whose claims the ambitious mind was always alive to every prospect of aggrandisement, laid claim to the crown of that kingdom in right of his mother; but, as the title of Philip had been universally acknowledged by the French nation, he did not think proper to insist in his pretensions at present, and probably would never have further thought of them, had not some circumstances occurred which kindled a quarrel between the two sovereigns.

Robert d'Artois, who was descended from the blood royal of France, and was married to Philip's sister, had been deprived of the county of Artois by Philip the Fair, and, in attempting to recover it by forgery, was detected, and obliged to fly the kingdom. He found refuge and protection in the court of England, and, being a man of abilities, was soon admitted into the councils and confidence of the king. This excited the resentment of the French monarch, who had also given serious cause of complaint to Edward, by protecting the exiled David Bruce, and encouraging the Scots in all their struggles for independence. Mutual threatenings and recriminations soon led to open hostility. Edward, at an immense expense, had formed alliances in the Low Countries, and on the frontiers of Germany; but it was difficult to bring so many petty sovereigns to act with union and determination. He was at last, however, enabled to appear in France with an army of 50,000 men. Philip opposed him with a force double its strength; but instead of coming to any decisive action, they merely encamped in face of each other, and, after some mutual bravados, Edward was compelled by his exhausted finances to retire into Flanders, and disband his army.

The debts which he incurred in this fruitless expedition, and his preparations for another campaign, obliged him to have recourse to parliament for an extraordinary supply. This was granted upon condition of his confirming the two charters, the charter of the boroughs, and of remedying some lesser abuses. But as Edward had now assumed the title of King of France, and had quelled the arms of France with those of England in his seals and ensigns, the parliament thought it necessary also to declare that they owed him no obedience as King of France; and that, whatever might be the issue of his present enterprise, the two kingdoms must for ever remain distinct and independent. Having equipped a fleet of 250 sail, the king again embarked for the continent; but was met off the Flemish coast by the French fleet, consisting of 400 ships manned with 40,000 seamen. The action was begun by the English, who had gained the wind of the enemy. It was long and fiercely contested; but the Fleming's fleet having descried the battle from their shores, issued from the harbour, and with a considerable force, and decided on the day in favour of Edward. The French in this engagement lost 230 ships and 50,000 men. But this success was followed by no event of importance on shore. Edward took the field with 100,000 men, but was foiled in an attempt upon Tournay; and the only consequence of all his mighty preparations was a truce for twelve months. Disappointed at the unsuccessful issue...
of his plans, and harassed and affronted by his numerous creditors, Edward returned to England discontented with himself and with all around him. He now vented his ill-humour upon his own subjects. Finding, on his arrival, the Tower of London negligently guarded, he imprisoned the constable and all his officers. He then dismissed and punished the officers of the revenue. He displaced and imprisoned the bishops of Chichester and Lincoln, his chancellor and treasurer; as also the keeper of the privy seal, the chief justice, and the mayor of London. Stratford, Archbishop of Canterbury, who had been entrusted with collecting the taxes, fell also under his displeasure; but that prelate being abroad, escaped the immediate effects of his resentment. He was no sooner, however, informed of the king's indignation, than he resolved to maintain the privileges of his character. He issued a general sentence of excommunication against all who should exercise any violence on the persons or the goods of clergymen, and even wrote to Edward that the royal authority was subordinate to the apostolic dignity. The king sought to humble the primate, and, as a mark of disrespect and resentment, sent him no summons to attend the next parliament. Stratford was not discouraged, but repaired to the parliament-house, arrayed in his pontifical robes, and demanded admittance as the first peer of the realm. He was refused for two days, but was at last allowed to take his seat, and was reconciled to the king.

Edward, impelled by his necessities, was obliged, in order to procure money, to aequicere in almost any measures which his parliament might propose; and they, taking advantage of his situation, passed an act, which made considerable encroachments upon the ancient prerogatives of the crown. They required that the great charter should be confirmed anew by the king; and that all the great officers of the state should also take an oath to observe it; that no peer should be punished, but by the award of his peers in parliament; and that the ministers of the crown should be amenable to parliament for their conduct in the discharge of their public duty. Edward consented to this statute; but he had no sooner received the promised supply, than he annulled it; and, about two years after, even prevailed upon the parliament to repeal it.

A.D. 1311.

Affairs on the continent began now to wear an aspect more promising to Edward's ambitious views. The Count of Boulogne seized upon Brittany, to the exclusion of his brother's daughter, who had been invested in the duchy during the lifetime of her father, and had been married to Charles of Blois, nephew to the king of France. Charles was powerfully supported by his uncle in the recovery of his wife's inheritance; while Mountfort strengthened his usurpation by an alliance with the King of England. War was immediately renewed; but, in the very outset of the contest, Mountfort was taken prisoner, and conveyed to Paris. This accident seemed to give a fatal blow to his pretensions. His fortunes, however, were soon retrieved by the magnanimity of his countess, who, having assembled the inhabitants of Rennes, presented to them her infant son, as the only male remaining of their ancient princes, and conjured them, if they had any regard to their ancient liberties, to save them from the dominion of France, by defending the rights of her family. They unanimously declared their resolution to live and die in her cause; and their example was followed by all the fortress of Britany. Having placed the province in a proper state of defence, she shut herself up in the fortress of Hennebont, where she was immediately invested by Charles of Blois. During the siege, she displayed the most heroic courage and indefatigable perseverance. The garrison, animated by her example, performed prodigies of valour; and when their strength was nearly exhausted, she broke through the enemy's line with a small force, retired to Brest, and forced her way back with a reinforcement of 500 cavalry. All her exertions, however, were unable any longer to resist the numbers of the besiegers, and she was upon the point of capitulating, when success from England rescued her from her perilous situation.

After five years of almost constant warfare, in which successes of neither party had gained any material advantage, the memorable battle of Cressy established the fame of England, and secured to Edward a footing in the kingdom of France. Accompanied by his principal nobility, and his eldest son Edward, Prince of Wales, usually denominated the Black Prince, from the colour of his armour, and then only fifteen years of age, the king of England embarked with a strong force for the relief of Guîenne; but the winds proving contrary, he ordered the fleet to steer for the coast of Normandy, and landed his army at La Hague. The French, under the Count d'Eau, constable of France, attempted to oppose his approach to Caen; but they fled at the first onset, and the constable was taken prisoner. The English army, scattered over the country, was destroyed and pillaged wherever they came without opposition, and carried their ravages to the very gates of Paris. Philip, with 100,000 men, advanced to Reuen; but Edward retired before his superior numbers, and hastened by rapid marches towards Flanders. The impatience of Philip, however, to be revenged upon his invaders, who had dared to insult him in his very capital, hurried him forward with such precipitation, that Edward was under the necessity of hazarding an engagement, or of exposing his rear to the attacks of a numerous cavalry. The King of England accordingly halted near the village of Cressy, and, having chosen an advantageous position, disposed his army in three lines, and awaited the approach of the enemy. The first line was entrusted to the Prince of Wales, with the Earls of Warwick and Oxford under him; the Earls of Arundel and Northampton commanded the second; and the king took charge of the third. The French soon after arrived in great disorder, and overpowered with fatigue. They immediately drew up in battle array. The van, consisting of 15,000 Genoese cross-bowmen, was led on by Anthony Doria and Charles Grimaldi; the heavy armed cavalry formed the second division, and were commanded by the Count of Alençon, brother to the king; and Philip himself brought up the rear. The Genoese began the attack, but were soon obliged to give way before the English archers; and, falling back upon their cavalry, threw both lines into confusion. The Prince of Wales perceived the favourable moment, and rushed with his division to the charge. He was followed by the second line; but the French cavalry, recovering themselves, and encouraged by the example of their leader, made such a desperate resistance, that the battle was long and doubtfully contested. The Earl of Warwick, apprehensive of the issue, from the superior numbers of the enemy, sent to entreat Edward to advance to the relief of the prince. The king was viewing the action from an eminence; and asking the messenger if his son was wounded or slain, he was answered in the negative. "Tell my son then," said he, "that I reserve the honour of this day to him. He will be able, without my assistance,
to repel the enemy." This confidence of their monarch inspired the prince and his companions with fresh courage; and young Edward that day performed such feats of valour, as filled even veterans with astonishment. The French cavalry were again thrown into disorder, and their leader slain. Their whole army soon after took to flight, and were pursued without quarter, till darkness saved them from the rage of their enemies. In this battle there fell on the side of the enemy, the Kings of Bohemia and Majorca, the Dukes of Lorraine and Bourbon, the Earls of Flanders, Blois, Vaucluse, and Aumale, with 36,000 combatants; while the loss of the English was very inconsiderable.

Edward followed up his victory by the siege of Calais, which employed him near a twelvemonth. But while he was engaged in this enterprise, the Scots under David Bruce entered Northumberland with an army of 50,000 men, and carried devastation and terror to the gates of Durham. Queen Philippa, in the absence of her husband, undertook the defence of the kingdom, and, with a very inferior force, ventured to give battle to the enemy at Neville's Cross. The Scots were routed with great slaughter, and King David was taken prisoner. The Queen having secured her royal captive in the Tower, proceeded to Calais, and there, by her prudence and humanity, did more for the honour of her husband and of the kingdom, than by the victory which she had so lately won. John of Viennne, the brave governor of Calais, had, during a lengthened siege, resisted all the attempts of the English with the greatest ability and courage. But despairing of relief, and being reduced to the last extremity by famine and fatigue, he offered to surrender the fortress, upon condition that Edward would ensure the lives and liberties of its brave defenders. Edward had been incensed by their stubborn resistance, and had resolved to take exemplary vengeance on them. He was prevailed upon, however, to mitigate his severity; and only insisted that six of the principal citizens should be delivered up to his resentment, with ropes about their necks, and the keys of their city in their hands. These conditions appeared even more hard than their general destruction; and the inhabitants were lost in despair, when Eustace de St Pierre offered himself the first victim for the safety of his friends. Five others soon followed his example; and these heroic men were led like malefactors to the tent of the English monarch. They laid the keys of Calais at his feet, when he gave the barbarous order for their execution. But the treachery of Philippa saved his memory from disgrace. She obtained the pardon of these gallant burgesses, and having entertained them in her own tent, dismissed them with presents. In order to secure the possession of this important fortress, Edward emptied the town of its inhabitants, and repeopled it with English, which was probably the means of preserving this conquest so long to his successors. A truce was soon after concluded between the two sovereigns, and Edward returned in triumph to England. but scarcely had it subsided, when the flames of war again began to rage.

John had succeeded his father Philip in the throne of France, but though possessed of many accomplishments, great personal courage, and the nicest sense of honour, he was deficient in foresight and prudence. His kingdom was torn by intestine commotions, which at last kindled into open rebellion. Edward, ever ready to take advantage of every disturbance in the rival kingdom, determined to support the French malcontents. The Black Prince entered France on the side of Guienne, and ravaged with impunity the whole of Languedoc, while his father, with a numerous army, overran and plundered the open country between Calais and St. Omer. Young Edward, encouraged by his past success, took the field in the following spring with 19,000 men, and attempted to penetrate through France, and join the Duke of Lancaster in Normandy. But finding the bridges on the Loire broken down, he was on the point of returning, when he was intercepted near Poictiers by the French monarch, at the head of an army five times his number. Seeing all retreat impracticable, the Prince chose his ground with the most consummate skill, and prepared for battle. But sensible of his desperate situation, he listened to the mediation of the Cardinal of Perigord, and offered to purchase his retreat, with the cession of all the conquests which he had made in this and the former campaign; and farther, engaged not to serve against France for seven years. John, however, required that he should surrender himself a prisoner, with a hundred of his attendants. Edward indignantly replied, that whatever might be his fate, England should never be obliged to pay his ransom. All hopes of accommodation being thus cut off, both sides left their cause to the decision of the sword. The English army was stationed at the extremity of a narrow defile, covered on each side by hedges, which Edward had lined with archers, through which the enemy must pass before he could take advantage of his numbers. As the French advanced, they were annoyed on each side by the English archers, against whom they were unable to retaliate, and were soon thrown into confusion. An ambush of 600 men under Capitale de Bueche, also attacked them in the rear, which spread such a panic, that the greatest part of their army took to flight. King John with his division alone, maintained his ground, and attempted to retrieve by his valor the fortunes of the day; but being at last deserted by his cavalry, he was overpowered by numbers, and taken prisoner with his youngest son, who had been wounded while fighting valiantly in defence of his father. The French monarch was received with every mark of sympathy and respect. Instead of being puffed up with exultation at his unexpected success, he ascribed his victory not to his own merit, but to a superior Providence, which controls all the efforts and prudence of men; and at a rap- past which he ordered to be prepared for the royal prisoner in his own tent, he stood behind the king's chair as if he had been one of his retainers, and repeatedly refused to take a place at table. Such unassuming modesty and genuine heroism, excited the admiration even of his enemies, and has added more to the glory of his name than all his military achievements. The victory of Poictiers was followed by a truce for two years; and, in the following spring, the Prince of Wales conducted his prisoner to England. They landed at Southwark, and entered the capital amidst an im-

\[\text{History.} \]

\[\text{Bravery of the Black Prince.} \]

\[\text{The Scots defeated, and their king taken prisoner.} \]

\[\text{Siege of Calais.} \]

\[\text{Truce with France.} \]

\[\text{Plague in London.} \]

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 manganese concourse of spectators. The captive king rode a white charger splendidly caparisoned, while his conqueror attended him upon a black palfrey. John experienced the same generous treatment from the father which he had received from the son; but was led by his misfortunes to submit to a treaty, which would have ruined and dismembered his kingdom. He agreed to restore all the provinces which had been possessed by Henry II. and his two sons, without any obligation of homage or fealty. This pernicious treaty, however, was rejected by the Dauphin, who had assumed the government upon the captivity of his father, and who was resolved to maintain the integrity of his dominions. Edward endeavoured to compel him to submission; and entering France with 100,000 men, laid waste the provinces of Picardy and Champagne, and advanced to the gates of Paris. The prudent Dauphin, sensible of his inability to withstand such a force in the field, had resolved to act upon the defensive. He filled all the considerable towns with proper garrisons and stores, and shut himself up in the capital. Unawed by the presence of the enemy before his gates, he maintained his resolution; and Edward, after desulting the open country, found it prudent to accept more moderate terms of peace. The treaty of Bretigny was accordingly concluded, by which it was stipulated, that King John should pay three millions of crowns of gold for his ransom, about £1,500,000 of our money; that the King of England should for ever renounce all claim to the crown of France, and to the provinces of Normandy, Maine, Touraine, and Anjou, and should receive in return the full sovereignty of Guienne, with the provinces of Poitou, Xaintonge, l'Agenois, Perigort, the Limousin, Quercy, Rouergue, l'Angoumois, and other districts in that quarter, also Calais, Guisnes, Montreuil, and the county of Ponthieu; and that France should renounce all title to feudal jurisdiction or homage, or appeal from them. These terms, though severe and very disadvantageous to France, John, as soon as he had regained his liberty, prepared to execute with the most scrupulous fidelity; but he found considerable difficulty in accomplishing his honourable intentions, from the great reluctance which many of the towns and vassals in the ceded provinces shewed in submitting to the dominion of England. That no endeavours, however, might be wanting on his part, to adjust all differences between the two kings, he resolved to take a journey to England; and when his council endeavoured to dissuade him from this step, and hinted their displeasure at his anxiety to fulfil a treaty which necessity alone had forced him to accept, he made this memorable reply, "That though good faith were banished from the rest of the earth, she ought still to retain her habitation in the breasts of princes." This good prince died while in England, and was succeeded by his son Charles the Wise, who had more political prudence, but less integrity than his father.

Young Edward, who had been invested with the sovereignty of the conquered provinces, under the title of the principality of Aquitaine, had involved himself in debt, by an expedition which he undertook for the restoration of Peter the Cruel to the throne of Castile, and was under the necessity of imposing a heavy tax upon his new subjects. This measure excited general discontent, and some of the nobles even carried their complaints to the King of France. Charles considering this a favourable opportunity of reviving his claim of lord paramount in these provinces, cited the Prince of Wales to appear at Paris, to justify his conduct towards his vassals. The Prince answered that he would come to Paris, but it should be at the head of 60,000 warriors. Hostilities immediately commenced, and the French, aided by the favourable disposition of the inhabitants, and no longer opposed by the abilities of the Black Prince, who was obliged, on account of his infirm state of health, to return to England, made such progress in their conquests, that they soon regained almost all that they had lost by the treaty of Bretigny. Calais, with Bourdeaux and Bayonne, alone remained to Edward of all his vast possessions on the continent.

The Prince of Wales, after a lingering consumption, died at Westminster in the 46th year of his age; and his father survived him only about a twelvemonth. He died at Kew in Surry, in the 65th year of his age, and 51st of his reign. The reign of Edward III. is one of the longest and most glorious in the annals of England. The discontents and dissensions occasioned by the weakness of his predecessor, were forgotten in the domestic tranquillity which succeeded. He curbed the licentious spirits of the nobles, by the prudence and vigour of his administration; and gained their affections by his affability and munificence. He drained the kingdom, however, of its wealth and population, by his foreign wars, which, though they added to his own fame and aggrandizement, were of no real utility to his people. His valour and military talents were only outshone by those of his son, whose name, while it spread terror among his enemies, was hailed among his countrymen with the warmest feelings of enthusiasm and affection. The warlike achievements of young Edward were the least of his praise. He had won all hearts by his affability, kindness, and moderation; and the many eminent virtues for which he was distinguished, would have rendered him an ornament to human nature in any country or age. England had long to regret her loss, in the disturbances and insurrections which distracted the succeeding reigns.

Richard II. the son of the Black Prince, ascended the throne of his grandfather, when only eleven years of age. The administration of the government, which had been in a great measure intrusted by Edward, during his old age, to his second son the Duke of Lancaster, was still retained by that prince, who was supported by the authority of his two brothers, the Dukes of York and Gloucester. As Edward had fixed upon no plan of government during the minority of his grandson, a council of nine peers was appointed by parliament, with full powers to conduct the business of the state for one year. The administration was carried on in the king's name; but the sovereign authority virtually resided in his uncles. These princes kept in obedience the turbulent barons, who were always ready to take advantage of any change in the government, and their opposite characters also served as a check upon each other. Lancaster was reserved and unambitious; York was weak and indolent; but Gloucester possessed considerable abilities, was bold and enterprising, and had besides gained the favour of the people. Richard himself was of a violent temper, and, though young and inexperienced, could not brook the subjection in which he was kept. He was immediate in his expences and pleasures; and often neglected the most important affairs, that he might indulge in indolence or amusement. The wars which his grandfather had left him to finish, had exhausted the treasury, and impoverished his people; and the parliament, in order to relieve his exactions, had recourse to a poll-tax, which was the cause of much discontent. They imposed three groats a head
upon every male and female above fifteen years of age.

This new and oppressive measure met with universal opposition among the lower classes; and their murmurs and complaints were heighted by the harangues of a seditious preacher called Ball, who inculcated the doctrine of liberty and equality, and inveighed against the insolence and injustice of their rulers. Their minds were thus prepared for resistance, and it required only a spark to kindle them into a flame.

This tax was fanned out to tax-gatherers, and was levied with great rigour. One of these men, having demanded payment for a blacksmith's daughter, whom her father asserted to be below the age, was proceeding to indecent familiarities in order to ascertain the fact, when the father, enraged at his insolence, dashed out his brains with his hammer. This resolute action gave courage to his neighbours, and they immediately flew to arms. The spirit of sedition spread rapidly through the kingdom; and, before the government were aware, 100,000 insurgents were assembled. Blasphemy, demanding recourses to grievances. Their leaders had assumed the feigned names of Wat Tyler, Jack Straw, &c., and entering the city, burned the Duke of Lancaster's palace, murdered all the gentry or nobility that fell into their hands, particularly lawyers and attornies, and pillaged the warehouses of the rich merchants. At length the king invited them to a conference, that he might know their demands. They required a general pardon; the abolition of slavery; freedom of commerce in market towns, without toll or impost; and a fixed rent on lands, instead of the services due by villenage. These reasonable requests were complied with, and charters to that purpose were immediately granted. But while the rebels were thus satisfied in one quarter, another party of them under Wat Tyler had entered the Tower, and murdered the Primate, Sir Robert Hakins the treasurer, and some others of the nobility. The king met this tumultuous band in Smithfield, and entered into a conference with their leader. But Tyler, who had grown bold with success, blazoned with pride and insolence, addressing his Majesty, that Walworth, the mayor of London, enraged at his presumption, fell him to the ground with his mace, when he was instantaneously dispatched by others of the king's attendants. The mob seeing their leader fall, were about to sacrifice the king and all his retinue to their resentment, when Richard advanced to them with an intrepid countenance, and asked them, "What, my good people, is the meaning of this disorder? Are you concerned at the loss of your leader? I am your king. Follow me, and I will be your leader." The populace, overawed by his manner, followed him as if mechanically. He led them out of the city into the fields, and there peaceably dismissed them with the same charters that had been granted to their friends. The barons, hearing of the king's danger, soon after joined him with all their retainers, when he found himself at the head of an army that defied all opposition. The concessions that had been made to his people were then revoked by parliament; and several of the leaders of the mob were seized, and severely punished.

The extraordinary presence of mind which the king had shewn on this occasion, gave hopes that he would emulate the glories of his grandfather; but these were soon dissipated by the discovery of his indulgence and incapacity.

Since the death of Edward, the war with France had been carried on without any event of importance. The Duke of Gloucester had traversed from Calais to Brit
framed, and ratified by parliament, by which a council of fourteen persons was appointed, to whom was transferred the sovereign power for one year. In this measure Richard was also obliged to acquiesce; but at the end of the session, he publicly entered a protest, that the prerogatives of the crown should still be deemed entire and unimpaired. He could not, however, but see that he was in a manner dethroned; and his violent temper soon urged him to seek the means of recovering his lost authority. He first endeavoured to gain over the Commons to his interest, by influencing the elections. But this failing, he had recourse to the judges, who encouraged him in resisting the authority of the council. They declared that the late commission was altogether derogatory to the prerogatives of the crown, and that those who supported it were guilty of treason. They also gave it as their opinion, that the king alone has the right of dissolving the parliament at pleasure; that that assembly, when it sits, must first proceed upon the king's business; and that it cannot, without his consent, impeach any of his ministers and judges.

Gloucester at once perceived the king's intentions, and, in order to prevent their execution, he and his adherents assembled their vassals near Highgate, and demanded that those persons who had misled him by pernicious counsels should be delivered up to them. They accused the Archbishop of York, the Duke of Ireland, the Earl of Suffolk, Sir Robert Tresilian, and Sir Nicholas Brembre, as traitors to the king and kingdom. The Duke of Ireland levied some forces, and attempted to relieve his master; but he was defeated by Gloucester, and obliged to fly to the Low Countries. The rest also sought safety in flight; but they were condemned by the parliament as guilty of high treason; and Brembre and Tresilian, who had been discovered and taken, were executed. The other judges, who had given their opinion in favour of the king, were banished to Ireland. But the vengeance of Gloucester was still unsatisfied, and it fell upon Lord Beauchamp of Holt, Sir James Berners, and Sir Simon Burley, who were all condemned and executed. Bursley had been appointed governor to Richard by the late king and the Black Prince, and had attended him from his earliest infancy. He was generally beloved for his many good qualities, but his enemies were jealous of his influence over the king; and though the queen, whose amiable dispositions had acquired her the appellation of the "Good Queen Anne," interested herself in his behalf, and knelt for three hours before Gloucester, begging for his life; yet the tyrant was inexorable. This prince's power, however, which he had so wantonly abused, was but of short continuance. In less than a twelvemonth, Richard was enabled to recover his authority, though by what means is not known, but which he exercised for a time with great moderation. He placed the principal officers of the crown, who had lately been appointed by the opposition; and Gloucester and the Earl of Warwick were also removed, for a time, from the council. He confirmed, by proclamation, the general pardon which had been passed by the parliament; and endeavoured to engage the affections of the people, by remitting some subsidies which had been granted him.

During these domestic convulsions, the French war was scarcely heard of, and the battle of Otterburn was the only event that marked the hostilities with Scotland. This affair, however, proceeded more from a rivalry between the martial families of Percy and Douglas, than from any national quarrel. In this engagement, Douglas was slain, and Percy was taken prisoner; but both sides claimed the victory. A truce was now established with France for twenty-five years; and Richard, who had lost his queen, was allied to Charles' daughter Isabella, now only seven years old.

During this period also, the Duke of Lancaster, with the flower of the English army, had been prosecuting, in Spain, his claim to the crown of Castile; but after a vain and useless effort, he was compelled to resign it, upon receiving a large sum of money. On his return, he was received with great kindness by the king, who employed his authority to counterbalance that of his uncle Gloucester. This turbulent prince, however, still continued to excite divisions and rebellion; and the conduct of Richard tended too much to heighten, rather than to soothe the discontents of the nation. His time was spent chiefly in the company of worthless favourites, and the public treasures were dissipated in low pleasures and unprofitable amusements. The truce with France gave universal dissatisfaction, and Gloucester took advantage of this spirit to inveigh against the measures of government, and the pusillanimity of the king. He inflamed the minds of the people by the recital of their former victories, and compared the glories of the former reign with the indolence and effeminacy of the present. His popularity daily increased, and it was even alleged, that he contemplated the overthrow of the government, and the dethronement of the king. Richard at least was jealous and apprehensive of his popularity, and resolved, by some decisive measure, to counteract his ambitious designs. His impetuous temper would not allow him to deliberate, but he ordered Gloucester to be instantly arrested and conveyed to Calais. The Earls of Arundel and Warwick were seized at the same time, and a parliament was immediately summoned to deliberate upon the conduct of these noblemen. They were accused of high treason, in procuring the illegal commission, and in appearing in arms against their sovereign; to which they pleaded, that their crimes had been committed eight years before, and for which they had received repeated pardons. The defence, however, did not avail them. Arundel was executed, and Warwick was condemned to perpetual banishment in the Isle of Man. A warrant was next issued for bringing over the Duke of Gloucester from Calais, in order to his trial; but the governor returned for answer, that he had died suddenly of an apoplexy. The suspicions which this circumstance excited, were much to the discredit of the king's honour and humanity, for it was generally believed that his uncle was murdered by his orders. Indeed, in the following reign it was incontestibly proved before parliament, that he had been suffocated with pillows, by the command of his nephew.

After the fall of Gloucester and his adherents, Richard endeavoured to attach the opposite party more closely to his interests, by grants and preferments. The principal nobility now seemed devoted to his will; but it was the devotion of fear and interest, not of affection; and they waited only for a favourable opportunity to shake off the restraint under which they were held, and to transfer their submission to a more worthy object. While the king thus believed his government secure from further opposition, a quarrel happened among his friends, which, by his imprudent weakness, was rendered the cause of his future overthrow and destruction. The Duke of Hereford, son of the Duke of Lancaster, accused the Duke of Norfolk before parlia-
ment, of having spoken slanderous words against the
king: Norfolk denied the charge, and offered to prove
his innocence by duel. The challenge was accepted
by Hereford; and the lists were prepared at Coventry
before the king and a committee of parliament. The
combatants appeared in the field, and, after the usual
ceremonies, were about to engage, when Richard inter-
pose, and, without farther enquiry, ordered them both
to leave the kingdom. Norfolk was banished for life,
and Hereford for ten years; the one without being
convicted of any crime, the other without even being
charged with one. This decision produced general
disapprobation. Norfolk was so overwhelmed with grief
and despondence at the judgment awarded against him,
that he died soon after at Venice of a broken heart.
Hereford's conduct was more temperate and submis-
sive; and he behaved with such respect before the
king, that Richard remitted four years of his exile,
and granted him letters patent, by which he could take
possession of any inheritance that might fall to him
during his absence.

Hereford retired to Paris, where he met with a fa-
vourable reception from the French king, and soon
after entered into a treaty of marriage with the cousin
of that monarch, the only daughter of the Duke of
Berry. This alliance, however, excited the jealousy of
Richard, who resolved to prevent it, and dispatched
the Earl of Salisbury to represent the exiled Duke as
a person guilty of treasonable practices, and who would
never be allowed to return to his native country. The
resentment of Hereford, which he had hitherto endeav-
oured to conceal, now burst forth; and it was aggra-
vated by new injuries. On the death of his father, the
Duke of Lancaster, Richard revoked the letters patent
which he had given him, and seized upon his inheri-
tance. This determined the Duke to seek justice, and
attempt the recovery of his possessions by force of
arms; and he now, perhaps for the first time, cherish-
ed the thought of aspiring to the crown of England.
He was generally beloved, both on account of his piety
and valour; and all ranks had exclaimed against his ba-
nishment. He was also possessed of great prudence
and firmness, and was connected by blood or alliance
with the noblest families in England. The king, on
the contrary, was universally hated. His total disor-
der of justice, and of the public welfare, had estranged
from him the affections of his people; and his weak-
ess and effeminacy had excited their contempt. Their
minds were now ripe for a revolution; and while Richard
was indulging himself in careless security, his
throne was tottering to its fall. Unmindful of his pre-
carious situation, he imprudently undertook an expedi-
tion to Ireland, to revenge the death of his cousin the
Earl of Marche, who had been killed in a skirmish with
the native Irish. Hereford, who had now become
Duke of Lancaster, taking advantage of his absence,
came over to England with a few followers; and on his
arrival at Ravenspur in Yorkshire, was immediately
joined by the Earls of Northumberland and Westmore-
land, before whom he took an oath, that his sole object
was to recover the duchy of Lancaster, which had been
so unjustly withheld from him. This reasonable de-
mand was seconded by his numerous friends, and all
the malcontents of the kingdom; and before he reached
the capital, his army had swelled to 60,000 men.

The Duke of York, who had been left guardian of
the realm, and had collected an army of 40,000 men,
found his troops very little disposed to resist the re-
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enacted, that if any heretic should relapse or refuse to abjure his opinions, he should be delivered over to the civil magistrate by the church, and be committed to the flames before all the people. A statute, for the suppression of heresy, had been surreptitiously obtained by the clergy during the former reign, but as it had never received the consent of the commons, it was never put in execution, and was soon after repealed. But being now supported by the king and a formal statute, they proceeded to gratify their vengeance upon their opponents; and William Saltre, rector of St Osyth's in London, was selected as the first victim, who was made to stand for his erroneous opinions by the penalty of fire.

Henry, however, notwithstanding all his prudence and caution, was involved in numerous inquietudes. The Welsh, led on by Owen Glendour, a name revered among that people even to this day, continued for several years to give disturbance to his government; and the Scots, by their frequent incursions and devastations, kept the northern counties in constant alarm. Henry, in order to chastise those troublesome plunderers, assembled his forces and their retainers, and marched to Edinburgh without meeting with any resistance. He there summoned Robert II., to do homage for his crown; but the Scots were determined neither to submit, nor give him battle; and, satisfied with their useless bravado, he measured back his steps to England. In the following year, the Earl of Douglas passed the borders with 12,000 men, and, after ravaging the country, was returning home with his booty, when he was overtaken by the Percies at Homeldon. A fierce battle ensued, in which the Scots were completely routed, and Douglas, and many of the Scottish nobility, fell into the hands of the victors. As soon as the king was informed of this success, he commanded the Earl of Northumberland not to ransom his prisoners, as he expected, by detaining them in his own power, to make a more advantageous peace with Scotland. This demand was considered by that nobleman not only as an entrenchment upon his right of disposing of his prisoners as he thought best, which was acknowledged by the laws of war in that age, but also as an insult to one, who had been the means of placing him upon the throne. His discontent had also been inflamed by the refusal of Henry, to allow him to treat for the ransom of the young Earl of Marche, to whom he was nearly allied, and who had been taken prisoner by Glendour. These injuries determined him to withdraw his allegiance from Henry, and support the claim of the Earl of Marche, the true heir to the English throne. For this purpose, he entered into an alliance with Glendour, and received assurances of assistance from Douglas, whom he restored to liberty. But just when he was ready to take the field, he was seized with a sudden illness at Berwick. His son Harry Percy, however, took the command of the troops, and marched to Shrewsbury to join the forces of Glendour. The king fortunately had an army in readiness, which he was about to lead against the Scots; but as soon as he received intelligence of the rebellion, he hastened to Shrewsbury before the rebels could form a junction. Percy, impatient to engage, did not wait for the Welsh; and the night before the battle, he sent a manifesto to Henry, wherein, after charging him with perjury, usurpation, and tyranny, he denounced his allegiance, and set the king at defiance. The two armies were nearly equal in numbers, being about 12,000 strong; and their commanders were both renowned for their military at-
chievements. The battle was consequently long and fiercely contested. Henry and his gallant son, then only about fifteen years of age, exposed themselves in the hottest of the fight; and Percy and Douglas outvivelled their former deeds, by their desperate valour in that bloody day. Douglas seemed determined that the king should that day fall by his arm. He sought him all over the field; but as Henry had accosted several of his cap- tains in the royal garb, the sword of the Scottish chief- tain devoured many pretended kings. The death of Percy, however, who fell by an unknown hand, decided the victory in favour of Henry; and Douglas, with many of the rebel leaders, were taken prisoners.

When Northumberland heard of the fate of his army, he disbanded some reinforcements, with which he was hastening to join his son; and came with a small retinue to make his submission to the king at York. He pre- tended that his sole intention in arming, was to mediate between the parties, which Henry thought proper to ac- cept as an apology, and granted him a pardon. The only persons that perished by the hands of the execu- tioner in this rebellion, were the Earl of Worcester and Sir Richard Vernon, who were considered as the chief au- thors of the insurrection. The clemency of Henry, how- ever, could not attach Northumberland to his interests. That nobleman soon after engaged to join another rebellion, headed by the Earl of Nottingham and the Archi- shop of York; but they betook themselves to arms with- out waiting for their more powerful auxiliary. The Earl of Westmoreland, with a small body of royalists, met them at Shipton, and desired a conference between the two armies, persuaded them, by a promise of pardon, and a redress of all their grievances, to disband their forces on the field, which he engaged also to do on his part; but he had secretly given contrary orders to his own men, and when the rebels were dismissed, he seized their leaders, and carried them to the king, who was advan- cing with an army to oppose them. Henry still confined his severity to the heads of the party, and the prelate and Earl were the only persons that suffered. The Earl of Northumberland and Lord Bardolf, upon being informed of this disaster, fled to Scotland; but afterwards returning with some forces, they were defeated at Bram- ham by Sir Thomas Rokesby, and both fell in the ac- tion.

Henry, being now freed from his domestic enemies, began to look abroad to find some employment for the restless and disorderly spirits of his people. The dissen- sions which then agitated the monarchy of France, first invited his attention. During the indisposition of Charles VII, who, though a prince of great spirit and genius, was subject to frequent fits of insanity, which totally incapac- itated him from regularly exercising his authority, the administration of affairs in that kingdom was disputed between the dukes of Orleans and Burgundy. Henry first entered into an alliance with the Duke of Burgundy, and sent him a small body of troops to defend him against his enemies; but he soon after received more ad- vantagous proposals from the Duke of Orleans, which he accepted, and dispatched a greater force to the sup- port of his party. The opposite factions, however, had been brought to a temporary accommodation, when the exertions of the king of England were rendered fruitless and vain; and the declining state of his health prevent- ed him from renewing the attempt.

Though Henry was yet in the flower of his age, his end was visibly approaching; and before his death he became subject to fits, which at times robbed him of his senses. As his constitution decayed, his fears of losing his crown increased; and such was his anxiety, that he always slept with the royal diadem beside him on his pillow. The Prince of Wales, happening one day to enter his fa- ther's chamber, found him in a deep sleep, and supposing him dead, carried off the crown. The king, when he awoke and missed his crown, asked the prince, with marks of great displeasure, if he meant to rob him of his dig- nity before his death? "No," replied his son, "sup- posing your Majesty dead, I took the crown as my law- ful inheritance; but since I see you recovered, I restore it with much more pleasure; and may God grant you many happy days to enjoy it in peace." The king was seized with his last fit while at his devotions before the shrine of Edward the Confessor in Westminster Abbey, and expired in the 46th year of his age, and 13th of his

His death, 20th March, 1413.

Had Henry IV. come to the throne by the right of inheri- tance, he would have been considered one of the great- est monarchs that ever held the sceptre of England. He possessed great military talents, and his political wisdom has seldom been surpassed. Though surrounded with enemies who were continually plotting against his government, yet such was his vigilance in detecting a conspira- cy, and his activity and prudence in suppressing it when it rose to rebellion, that his authority was strength- ened by every effort that was made for its over- throw. His usurpation was certainly in many respects beneficial to the English nation. During his reign, the administration of justice became less arbitrary and less venal; the limitations of the government were more care- fully maintained; the House of Commons assumed powers which it did not before possess, and rose in importance and independence. But while we are pleased with the exer- cise of his authority, we cannot but detest the unjustifiable means by which it was obtained. Rebellion against his sovereign; the deposition and murder of his lawful king; and the exclusion of the rightful heir, are crimes that can never be regarded but with abhorrence. It was these that drew upon him the hatred of his subjects, and from being one of the most popular noblemen in the kingdom, Henry became one of the most unpopular kings that ever sat upon the throne. The intelligence of his death was received without regret, and was im- mediately forgotten in the sincere rejoicings that were made at the accession of his son.

Henry V. came to the throne with the tide of popularity flowing full in his favour. His noviciate in arms, which he performed at the battle of Shrewsbury, gave indica- tions of a great and military genius; and these were strengthened by several advantages which he gained over the brave Glendour in Wales. But his father, who was infected with all the jealousies natural to an usurper, had entertained unreasonable suspicions of the fidelity of his gallant son; and during the latter years of his reign, had excluded him from the command of his armies, and even from all public business whatever. The active and enterprising genius of Henry, being thus restrained from his proper exercise, broke out in the extravagancies of riot and dissipation. Surrounded by a crew of low and profligate companions, he indulged in all their disorderly humours and amusements. When heated with wine, he sometimes encouraged and seconded his associates in attacking and robbing the passengers on the streets and
highways, and enjoyed himself by laughing at the fears and regrets of these delinquent people. In the midst of his excesses, however, the nobleness of his heart often appeared through the clouds which his follies threw over his character; and even when plunged in the extremes of dissoluteness, he displayed such traits of genuine humanity and magnanimity, as gave good reason to cherish the hope of a speedy reformation. An incident is related of him which tended much to encourage that hope, and which shows, that when brought to reflection, he was ashamed of his irregularities and errors. One of his riotous associates had been indicted before Sir William Gascoigne, the chief justice, for some misdemeanour; and Henry appeared with him at the bar, on the day of his trial, to give him countenance, and to overawe the judge. Finding, however, that the criminal was condemned notwithstanding his interference, he was so exasperated, that he proceeded to insult the chief justice upon the bench; but Gascoigne, mindful of the dignity of his office, ordered the prince to be committed to prison for his rude conduct. Henry, as if struck at once with a consciousness of his fault, quietly submitted to his punishment, and acknowledged his errors. When his father was informed of this circumstance, it is said that he exclaimed, in a transport of joy, "Happy is the king who has a magistrate endowed with courage to execute the laws upon such an offender; still more happy in having a son willing to submit to such a chastisement!"

The first actions of Henry's reign confirmed all the hopes that had been entertained in his favour. He assembled his former companions; acquainted them with his intended reformation; forbade them to appear in his presence until they had learned to imitate his example; and dismissed them with liberal presents. The wise ministers of his father were retained in their offices, and received his favour and confidence; even the chief justice, who trembled to approach the royal presence, was applauded for his impartial conduct, and encouraged to persevere in a just and strict execution of the laws. Henry next endeavoured to extinguish the remains of faction, by burying all party distinctions in oblivion, and by exalting to honourable employments in the state, the adherents of either party, who were distinguished by their virtue or abilities. He restored the family of Percy to their fortunes and honours, and treated his competitor, the Earl of Marche, with such singular courtesy and kindness, that this gentle and unambitious nobleman ever after remained sincerely attached to his person and government. Such prudence and magnanimity gained him the affections of all ranks; and the defects of his title to the throne were forgotten in the high esteem and regard in which his personal character was held.

But the mind of Henry, though endowed with the most shining qualities, and sublimest virtues, had not escaped the superstition of the age, and in the religious differences which then agitated the kingdom, he was led to support, with his countenance and authority, the established clergy in all their oppressions. The Lollards had become formidable to the church by their numbers and popularity, and at their head was Sir John Oldcastle, Lord Cobham, a man of valour and abilities, who had been distinguished with the favour both of Henry and his father. The zeal and high character of this nobleman pointed him out to the clergy as a fit object of persecution. His punishment would strike terror into his party, and convince them that the laws enacted during the last reign for their suppression, would be rigorously enforced. The Archbishop of Canterbury, accordingly, applied to Henry for permission to bring Lord Cobham to trial for his heretical opinions; but the generous nature of the king was averse to such violent measures; and he first endeavoured, by a private conversation with that nobleman, to bring him to renounce his errors. Cobham, however, was resolute in maintaining his opinions; and Henry finding him immoveable, gave him up to the fury of his enemies. He was then indicted by the primate, and condemned to suffer death by fire. But he made his escape from the Tower before the execution of his sentence; and provoked by persecution, and stimulated by religious zeal, he was induced to attempt the most criminal enterprises. He endeavoured to rouse his party in defence of their principles, and formed the design of seizing the king's person, and taking vengeance on his enemies. But the attempt was frustrated by the activity of Henry, and the conspirators dispersed. Some of them were taken and executed, but the greater number were paroloned. Cobham, who had made his escape, after undergoing a variety of distresses, was apprehended about four years after. He was first hanged as a traitor, and his body was then burned on the gibbet as a heretic. This insurrection served only to bring discredit upon the reformers, and checked for a time the progress of their party. More severe laws were enacted by parliament against their opinions, which were now regarded as treasonable and dangerous to the state; and all magistrates were obliged to take an oath that they would use their utmost endeavours for the extirpation of heresy.

The ambitious spirit of Henry was now invited to engage in enterprises more congenial to his wishes. The animosities of the rival families of Orleans and Burgundy had broken out afresh, and their hatred became more implacable than ever. The Duke of Burgundy, by an act of the basest treachery, had procured the assassination of his rival in the streets of Paris; and the princes of the blood, combining with young Orleans, rose to avenge the murder of their relative. The civil wars were thus renewed, and consumed the very vitals of the monarchy. The unhappy king, seized sometimes by one party, sometimes by another, transferred alternately to each the appearance of legal authority. Henry resolved to profit by these confusions, and to attempt the recovery of those dominions which had formerly been given up in successive treaties with France. He accordingly sent ambassadors to Paris, demanding Catharine, the French king's daughter, in marriage, with two millions of crowns as her portion; the restitution of Normandy, with all the other provinces that had been wrested from England, together with the superiority of Brittany and Flanders. This message threw the French court into the utmost consternation. They knew the abilities of their enemy, and were conscious of their own desperate condition. They therefore endeavoured to avert the danger by negotiation. They replied that they were willing to give him the princess in marriage, with eight hundred thousand crowns; to resign the full sovereignty of Guienne, and to annex to it the country of Perigord, Rovergne, Xaintonge, the Artois, and other territories. But Henry was deaf to their proposals; and as he could have no expectation of his own demands being complied with, he had been diligently preparing for war. He had assembled a large
Henry invades France. A.D. 1415.

Henry now turned his arms against the Dauphin, who was unable to keep the field. He made himself master of Sens and Montereau, and after an obstinate resistance, took Melun. But the want of supplies obliged him to go over to England. During his absence, the Dauphin had been reinforced by 7000 Scots, under the Earl of Buchan, and had obtained considerable successes in Anjou. At the battle of Baugé, the English, under the Duke of Clarence, the king's brother, were completely defeated; the Duke himself slain, and the Earls of Somerset, Dorset, and Huntingdon, taken prisoners. But the return of Henry with a numerous army, soon restored the fortune of his arms. The Dauphin was compelled to retire before him. The principal fortresses which were held by the adherents of that prince, fell into his hands; and he himself was driven beyond the Loire, and threatened with total destruction. In the midst of these successes, the Queen of England was delivered of a son, which occasioned great rejoicings, both at London and Paris. The infant prince was called by his father's name, and seemed to be universally regarded as the future heir of the two most powerful monarchies in Europe.

But Henry was cut off in the zenith of his glory by the stroke of death. He was seized with a fistula, a disease at that time not sufficiently understood, and sensible that his end was approaching, he proceeded to regulate the government of his kingdom and family. He left the regency of France to his elder brother, the Duke of Bedford; that of England to his younger brother, the Duke of Gloucester; and the care of his son's person to the Earl of Warwick. He advised them never to restore the prisoners taken at Agincourt till his son came of age; and to endeavour, by every means, to maintain the friendship of the Duke of Burgundy, by whose assistance alone they would be enabled to place young Henry upon the throne of France. He also treated them to continue towards his son that fidelity and attachment which he himself had so happily experienced during his lifetime. He then applied himself to his devotions, and expired at the castle of Vincennes in the 34th year of his age, and 10th of his reign.

A.D. 1419.

The general character of this prince, as well as his splendid achievements, endeared him to his subjects, and his memory is still held in reverence by his countrymen. He attached his friends, by his affability and engaging manners; and he overcame his enemies, by his address and clemency. His magnanimous conduct towards the Earl of Marche, who was the rightful heir to the throne, shows his superiority to the petty jealousies which generally influence princes in similar situations; and his character for candour and sincerity must have been firmly established, when his rival could rely so entirely on his
friendship. The exterior figure of Henry was also highly prepossessing. His countenance was beautiful; his limbs graceful and slender, but full of vigour; and his stature somewhat above the middle size.

Henry VI.

Upon the death of Henry, the English parliament proceeded to arrange the administration of the government during the minority of his son. They entirely departed from the will of Henry. They declined the title of regent with regard to England, and appointed the Duke of Bedford protector or guardian of that kingdom. They invested the Duke of Gloucester with the same dignity during his brother's absence, while conducting the war with France; and entrusted the person and education of the young king to his great uncle, the Bishop of Winchester.

The Duke of Bedford continued to prosecute the war in France with the same success which had distinguished the arms of Henry. He had strengthened himself by an alliance with the Duke of Brittany, and had also procured the neutrality of Scotland. But while employed in these negotiations, he at the same time pushed his conquests with such vigour, that the Dauphin, who, on the death of his father, had been crowned at Poictiers by the name of Charles VII, was reduced to the last extremity. The fatal battle of Verneuil had deprived him of the bravest of his nobles, and the flower of his army. He wandered a stranger in his own dominions, without any resources for recruiting or subsisting his troops; without even money sufficient for the decent subsistence of himself and a few followers. The towns which were held by his adherents, though bravely defended, were daily surrendering to the enemy for want of relief or supply; and he had the dismal prospect of being soon stripped of all his patrimonial dominions. But the dissensions of his enemies relieved him from his fears, and restored to him the territories which he had lost. The Duke of Brittany withdrew from the English alliance, and joined himself to Charles, which gave to his affairs a more favourable aspect; and the discomfiture of the English at the siege of Orleans, which was defended by the famous Joan of Arc, was the beginning of disasters, which gradually led to the destruction of the English interest in France. This was hastened by the defection of the Duke of Burgundy, and the death of the Duke of Bedford; and though they continued for several years after to carry on an unequal war, they daily lost ground, and in 1450 were finally expelled from all their conquests in France, except Calais and Guienne. See FRANCE.

While England was sacrificing her best blood and treasure in schemes of foreign aggrandizement, which, had they proved successful, would have degraded her into the rank of a dependent province, the government at home was distracted by intestine disputes. The Cardinal of Winchester, who was a man of abilities, but of an intriguing and aspiring character, had obtained an ascendency in the English council, and employed all his authority in counteracting the designs of his nephew the protector. The Duke of Gloucester, on the other hand, by his generosity and amiable manners, had acquired great and deserved popularity; but his open and hasty temper enabled his rival to gain many advantages over him, and at last to accomplish his destruction. Their sentiments were particularly opposed with regard to affairs in France. The Cardinal had always encouraged every proposal of accommodation, while the high-spirited Gloucester would not relinquish the high pretensions of his brothers, and still entertained hopes of prevailing over the enemy. But he was overruled in all his measures, and the war with France was left to languish through neglect and want of succours; and a truce for twenty-two months was soon after concluded by the influence of the Cardinal. This measure was followed by another still more hostile to the authority of Gloucester.

Henry had now come of age, but had given no indications of a capacity, or even of a desire, to hold the reins of government. It was, therefore, easy to foresee, that his reign would prove a perpetual minority; and the Cardinal taking advantage of the king's situation, resolved to raise up a more powerful opponent to the protector in the person of the queen. For this purpose, he had fixed upon Margaret of Anjou, daughter of Regnier, titular king of Sicily, Naples, and Jerusalem, and niece of the French monarch. She was a princess entirely without fortune, but was highly accomplished both in body and mind. She possessed great resolution and penetration, and was every way qualified to supply the defects and weaknesses of her intended husband. This match was opposed by the Duke of Gloucester, who proposed a daughter of the Count of Armagnac, but he had not sufficient influence to carry his point; and the Earl of Suffolk, after negotiating the truce with France, was empowered by the council to make proposals of marriage to the Sicilian princess. These were immediately accepted; and Suffolk, on his return, was raised to the rank of Duke, and received the thanks of parliament for his services.

The queen at once entered into all the measures of the cardinal and his party; and her first authority was employed in removing Gloucester from the council board. His enemies had taken every opportunity to thwart his opinions, and to wound his happiness. They first endeavoured to render him odious in the eyes of the public, whose favour he possessed in a high degree, by accusing his Duchess of witchcraft. It was pretended that she, in concert with Sir Roger Bolingbroke, a priest, and one Margery Jordan of Eye, a reputed witch, had made a waxen figure of the king, which they melted before a slow fire. As the wax dissolved, the king's strength was supposed to waste, and, upon its total dissolution, his life was to be at an end. This absurd accusation was listened to by the credulous king, and the duchess and her associates were brought to trial. Neither their innocence nor her rank could save them. They were pronounced guilty. The duchess was condemned to public penance, and perpetual imprisonment; Bolingbroke was hanged, and the woman was burnt. The public, however, were sensible that this violence arose entirely from the malice of the Duke's enemies, and, instead of taking part against the perpetrators of these imaginary crimes, as was their usual practice, they pitied the unhappy sufferers, and increased their esteem and affection towards the generous and persecuted Gloucester. The death of this prince was almost a necessary consequence to these proceedings. His enemies knew well, that he could never forgive such cruel injuries, and they had reason to dread the effects of his resentment. They therefore resolved to free themselves from their danger, by his destruction. A parliament was summoned to meet at St Edmondsbury, which was at some distance from the scene of his popularity, where he was accused of treason, and thrown into prison. But on the day appointed for his trial, he was found dead in his bed. Though his enemies en-
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Stafford was sent with a small force, to quell the insurrection; but he was defeated and slain, in an action with the rebels near Sevenoak; and Cade, advancing with 20,000 followers, encamped on Blackheath. He sent to the court a list of grievances, and demanded the punishment of Lord Say the treasurer, and Cromer, sheriff of Kent, for their malversations. The king retired to Kestworth, and the capital immediately opened its gates to the rebels. Cade at first maintained great order and discipline among his followers, whom he always led out into the fields during the night. But he was obliged to gratify them by the death of Say and Cromer, when they became so unruly, that his orders were unheeded. They broke into the house of a rich citizen, which they plundered; and this act of violence so alarmed the inhabitants, that they shut their gates against them. Cade endeavored to force his way, but was defeated with great slaughter; and the Archbishop of Canterbury, who was then chancellor, having proclaimed a general pardon to the rebels, they retreated to Rochester, and dispersed. Cade was afterwards taken and killed, and many of his followers were executed.

The suppression of this rebellion did not bring quietness and security to the government. The clamours of the people continued as violent as ever; and were supported and encouraged by the appearance of a pretender to the throne. Richard Duke of York was the nearest heir to the house of Mortimer. His mother Anne, Countess of Cambridge, was sister to the last Earl of Marche, who died without issue, and thus he stood plainly in the order of succession to the throne, before the family of Lancaster. Richard had displayed great valour and abilities in his government of France, from which station he had been recalled by the intrigues of the Duke of Somerset. He was then sent to suppress a rebellion in Ireland, and here he was equally distinguished by his conduct and prudence, and had even been able to attach to his person and family that independent people, whom he was sent to subdue. The talents of this nobleman thus made him formidable; but he was rendered still more so by his powerful connections. He possessed immense baronial estates, and was connected by blood or alliance with the most potent and opulent noblemen in England. But with all his abilities and power, he was of a mild and moderate disposition; and his claim to the crown, which had lain so long dormant, would not have been revived by him, had he not been encouraged to do so by the weakness and unpopularity of the present government. He was also in a manner compelled to it, by a regard to his own security. He had become an object of jealousy to the reigning interest, from his pretensions and his power; and he found it necessary to assert his right, in order to maintain his safety. He was even suspected of being concerned in the late discontents and insurrections, and of having secretly instigated Cade to rebellion, that he might ascertain the dispositions of the people towards his title and family. When the government heard that he intended to return from Ireland, they were afraid that he meant to bring a military force along with him, and issued orders to oppose his entrance into England. But he refused the summons of his enemies, by coming only with his ordinary attendants. He could not but see, however, the danger to which he was exposed as a suspected subject, and he therefore endeavored by every mean to strengthen his interest, and to be prepared against every emergency. His partisans were in-

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Popular discontent.

The murder of Gloucester covered the king and queen with universal odium; and the Duke of Suffolk, who was now raised to the office of prime minister, and was deeply concerned in that crime, partook also of the general hatred attending it. The popular discontent was farther increased by their arbitrary measures. They managed all things with unlimited authority; they disgusted the nobility by their overbearing pride, and the people by their oppressions. The murmurings of the people had become so loud and unequivocal, that Suffolk, sensible that he had become an object of public hatred, endeavored to allay the storm that was gathering around him, by boldly resisting its fury. He rose in his place in the House of Peers, took notice of the public discontent, and complained, that, after his long services both at home and abroad in maintaining the honour of his native country, for which he had been rewarded by his sovereign with the highest honours and distinctions, he should be exposed to its ingratitude and resentment. But this challenge, instead of silencing his enemies, served rather to provoke them; and the commons immediately sent up to the House of Peers an accusation of high treason against him, divided into several articles. These articles, however, were adopted without inquiry, and were founded entirely upon the popular clamours. They consisted chiefly in charging him with having designs upon the crown; and with being the cause of the English losses in France. Such a charge was easily refuted; and the commons themselves soon became sensible of its futility, and sent up a new charge of misdemeanors. They accused him of procuring exorbitant grants from the crown, of embezzling the public money, and of perverting public justice.—charges much more probable, and not so easily eluded. The king, alarmed at the prosecution of a favourite minister, summoned all the peers into his presence, and called upon Suffolk for his defence. That nobleman denied the charge, but submitted to the king's mercy. Henry, in order to allay the public discontent, banished him the kingdom for five years. This irregular proceeding, it was easily seen, was intended to screen the favourite; and, as he still possessed the queen's confidence, it was supposed that he would soon be restored to his former credit and power. But his enemies were determined that he never should return. He was intercepted in his passage to France, his head was struck off on the side of the long boat, and his body cast into the sea.

The Duke of Somerset succeeded to the power of Suffolk, and also to his unpopularity. It was under Somerset's government that the French provinces were lost; and the people, who judge only by the event, repaid him with their animosity and hatred. These passions soon broke out in open insurrections; and one Jack Cade, a low-born Irishman, who had been formerly obliged to fly into France for his crimes, excited a disturbance in Kent, which threatened the most dangerous consequences. He assumed the name of John Mortimer, pretending to be a descendant of that popular family, which drew to his standard a crowd of adherents. Sir Humphrey
structed to discuss his claim in all companies, and to maintain his right by succession, and by the established laws and constitution of the kingdom. The question being thus brought before the public, every one embraced one side or the other, according to his convictions, his feelings, or his interest; and the minds of men were thus insensibly led to cherish all those antipathies and prejudices, which afterwards burst forth with such a dreadful explosion, and which continued to fill the kingdom with slaughter and desolation.

The pretensions of both parties may be shortly stated. The family of Lancaster derived their descent from John of Gaunt, Duke of Lancaster, the third son of Edward III.; while the Duke of York was descended by the female line from Lionel, Duke of Clarence, second son of that monarch. The adherents of the former, while they allowed the advancement of Henry IV. to be irregular, maintained that it was founded upon general consent. It received the sanction of a free people, who were driven from their allegiance by the tyranny of their rulers, and gratefully bestowed the sceptre upon their deliverer; that, though the deposition of Richard II. was perhaps rash and imprudent, yet it was justified by the state of the nation, and it was now too late to remedy the evil; that the crown was entitled upon the family of Henry by reiterated acts of parliament, and were these acts to be now invalidated, the English must be considered not as a free people, who could dispose of their own government, but a nation of slaves, who were implicitly transmitted from one master to another; that the order of succession was established only for the general good, and could never be pleaded for the overthrow of public tranquility; that the nation was bound to the house of Lancaster by their oaths of fealty and allegiance, and were these oaths to be wantonly infringed, it would throw them loose from all principles, and expose them to continued revolutions.

It was replied in favour of the house of York, that it was never too late to correct any pernicious precedent; for, if it were allowed that present possession of power, and continuance in it for a few years, were sufficient to convert usurpers into legal princes, it would throw the throne open to every turbulent innovator; that the deposition of Richard II. and the advancement of Henry IV. were not deliberate acts of the legislature, but proceeded from the levity of the people, or were procured by violence and usurpation; that the maintenance of order in the succession, served to prevent those numberless confusions which must ensue, if no rule were followed but present advantage and convenience; that the restoration of the true order of succession could not be considered as a change which familiarised the people to revolutions, but only the correction of a former abuse, which had itself encouraged the giddy spirit of innovation, rebellion, and disobedience; that as the original title of Lancaster was founded entirely on present convenience, even that principle, unjustifiable as it was, had now gone over to the house of York. A weak king governed by corrupt ministers, or an imperious queen engaged in foreign connections, could never stand in comparison with a prince of approved wisdom and experience, and the lineal heir of the crown, who, by his restoration, would remedy those abuses, of which the nation so justly complained.

These arguments were keenly contested on both sides, and the people were completely divided in their sentiments and affections. Each party was distinguished by a particular symbol. The ensign of the house of Lancaster was a red rose; that of York a white one; and the civil wars which soon after followed, were known throughout Europe under the name of the quarrel between the two roses. This fatal quarrel, which lasted nearly thirty years, was signalized by twelve pitched battles; and eighty princes of the blood are computed to have fallen on the field or on the scaffold.

In a parliament assembled soon after the return of the Duke of York from Ireland, his adherents, encouraged by the general discontent against the administration, obtained a petition from the lower House, which prayed the king to dismiss the Duke of Somerset, the Bishop of Chester, and several others, from his presence and counsels. This request the king hesitated to grant. But it was soon after seconded by the appearance of the Duke himself, who had come to London at the head of 10,000 men, and demanded a reformation in the government, and the removal of the Duke of Somerset from all power and authority. The gates of the city, however, were shut against him; and on his retreating into Kent, he was followed by the king with a superior army. A conference ensued, in which Richard insisted on Somerset's being dismissed, and submitting to trial in parliament. This demand was seemingly complied with, and Somerset was put under arrest; but when Richard came to pay his respects to the king in his tent, and to repeat his accusation against the minister, he was surprised to see that nobleman step from behind the curtain, and offer to maintain his innocence. Richard now found himself in the hands of his enemies; but they judged it prudent to refrain from offering violence to one who was so popular and powerful, and dismissed him upon a promise of obedience. He then retired to his seat of Wigmore, on the borders of Wales.

But new discontenteds drew Richard from his retreat. An attempt was made to recover the province of Gascony from the French, which completely failed. The blame was laid upon the ministry; and Henry having at the same time fallen into a distemper, which rendered him incapable of exercising the royal power, the queen found herself unable to resist the opposite party; and the Duke of York was invited to take upon him the administration of the government. The Duke of Somerset was sent to the Tower, and Richard was appointed lieutenant of the kingdom. The parliament soon after created him protector during pleasure, and the way to the throne thus lay open before him. But Richard had not yet advanced any pretensions to the crown; and was even now irresolute about receiving the power that was offered to him. He desired that it might be recorded in parliament, that this high office was conferred on him without any application on his part; and that all his powers should be specified and defined. This excessive and amiable moderation, however, served only to encourage his enemies; and as soon as Henry had recovered so far as to have the appearance of directing the government, he was dismissed from the protectorship, and Somerset was again raised to the head of affairs.

Richard was sensible of the dangers which threatened him, and had recourse to arms. He still complained, however, only of the king's ministers; but his complaints were answered by the appearance of an army, commanded by Somerset and the king in person. In the battle of St Albans, Somerset was slain with 5000 of his party. Henry was wounded and taken prisoner, but was treated by his enemies with great respect and ten-
...and the attempt victed his described and his The His He was carried back in triumph to London, where the parliament restored the protectorship to Richard but limited its continuance to the period of the Prince of Wales' majority, who was now about three years of age. The queen, whose ambition, supported by her native vigour and perseverance, impelled her to attempt the recovery of her authority, prevailed upon her husband to re-assert his prerogative. She took advantage of the Duke of York's absence from court, and carried Henry to the House of Lords, to whom he signified his intention of resuming the government. This step was so unexpected, that no opposition was made to it; and it was accordingly declared that Richard was not a prince, but that the king was reinstated in the sovereign authority. The Duke even acquiesced in this irregular measure; but soon after, having reason to suspect that designs were formed against his life, he withdrew to his castle of Wingham. Hostilities were again about to be renewed; when the mediation of the Archbishop of Canterbury prevented for a time the eruption of blood. He proposed that the great leaders of both factions should meet in London, and be solemnly reconciled. An outward reconciliation was accordingly effected; and in a solemn procession to St Paul's, the Duke of York led Queen Margaret, and the chiefs of the opposite parties marched hand in hand with each other. But this seeming harmony was but of short continuance; a scuffle which happened between the retainers of the Earl of Warwick, and those of the king, revived their animosity and hatred. The Earl apprehending his life to be aimed at, fled to his government at Calais, and the Yorkists immediately prepared for hostilities. The royalists, under Lord Audley, in a through superior number, were defeated at Bloreheath by the Earl of Salisbury, who was hastening to join the Duke of York at Ludlow. But when a general engagement drew near, a body of veterans, which Warwick had brought over from Calais, deserted to the king, which so dismayed the rebel that they separated without coming to action. The Duke fled to Ireland, and the Earl of Warwick, with some of the chiefs of his party, retired to Calais. This nobleman was the most celebrated general of his age, and had rendered himself extremely popular among the military, by his bravery and munificence. Numerous partisans flocked to his standard, and he soon found himself in a condition again to take the field. He landed in Kent with the Earl of Salisbury, and Edward eldest son of the Duke of York, and was received in London amidst the acclamations of the populace. The royal army hastened from Coventry to give him battle. They met at Northampton, and the action continued for five hours. Both sides fought with the utmost obstinacy, but the desertion of Lord Grey of Ruthin, who commanded the van of the royalists, turned the battle in favour of Warwick, who gained a complete victory. The slaughter fell chiefly on the nobility and gentry; and the Duke of Buckingham, the Earl of Shrewsbury, with the Lords Beaumont and Egremont, were killed in the action or pursuit. Henry was again taken prisoner; but Margaret and her infant son escaped into Scotland. This victory was followed by the arrival of the Duke of York from Ireland, and a parliament was assembled at Westminster to decide upon his claim to the crown. Richard was now at the head of a victorious army, and could have stepped into the throne without resistance; but his moderation and irresolute temper made him averse even to the least appearance of violence. He now, for the first time, openly advanced his claim to the crown, and pleaded his cause before the House of Peers. He stated his title by descent; detailed the cruelties by which the house of Lancaster had paved their way to power; described the calamities which attended the present reign, and called upon them to do justice to the lineal succession. His claim was taken into consideration, and was solemnly debated for several successive days. It was at last decided that his title was certain and indefeasible; but it was also determined that Henry should enjoy the crown during life; that Richard should have the present administration of the government, and should be acknowledged the true and lawful heir to the monarchy, to the utter exclusion of the young son of Wales.

Margaret did not continue long in her retreat. Her spirit rose superior to her misfortunes. She possessed inexhaustible resources in the energies of her own mind. She animated her old friends by her courage and perseverance, and new ones were attracted by compassion for her helpless situation. No time was to be lost, and however unfavourable the present aspect of her interests, she determined again to assert the rights of her family. By her insinuating address, by caresses and promises, she so gained upon the northern barons, that they all armed in support of her cause; and she found herself at the head of an army 20,000 strong, before her enemies were informed of her intentions. The Duke of York hearing of her return, but unacquainted with her force, hastened with 5000 troops to suppress her adherents. But when he came to Wakefield, he was surprised to find himself completely outnumbered. Disregarding, however, the dictates of prudence and experience, he listened only to the suggestions of pride, and the mere chances of political success, was eminent for his personal bravery. He deemed it unworthy of his character and reputation to retire before a woman, and he boldly offered battle to the enemy. His little army was surrounded and cut to pieces: the body of Richard was found among the slain. His head was cut off by order of Margaret, and fixed upon the gates of York with a paper crown upon it, in derision of his title. His second son, the Earl of Rutland, and the Earl of Salisbury, were taken prisoners. Salisbury was immediately beheaded by martial law; the other, a youth only of seventeen, was barbarously murdered in cold blood by the Earl of Clifford, in revenge of his father's death, who fell in the battle of St Albans.

Margaret improved her victory by hastening to London, but weakened her army by sending a detachment under the Earl of Pembroke, against Edward, the new Duke of York. Pembroke was defeated at Mortimer's cross, with the loss of 4000 men. His father, Sir Owen Tudor, was taken prisoner, and immediately beheaded by Edward's orders; and this spirit of revenge, when once begun, continued to actuate both parties during this long protracted contest. On the approach of Margaret, Warwick, who had been left with the command of the Yorkists in London, led out his army, and gave battle to the enemy at St Albans. The Queen was again victorious. Warwick was compelled to fly and take shelter in the capital, which was firmly attached to his party, and the king was left in the hands of the victors. But Margaret was scarcely conscious of her triumphs, when she was threatened by the advance of Edward on the opposite side, with a superior army, and found herself under the necessity of retiring to the north. The young Duke then entered London amidst the shouts of the citizens. The beauty of his person, his youth, his...
bravery, and his amability, had secured their affections; but they were as yet unacquainted with his nature, which was cruel and unrelenting. He was more decided and resolute than his father, but he had none of his mildness and moderation. Aware how prejudicial these estimable qualities were to his father's cause, he resolved to throw aside all reserve; to insist openly on his right to the throne; and to assume at once the title and dignity of a king. He assembled the people in St. John's Fields; and after Warwick had harangued them on the title of Edward, and the tyranny of the rival family, they were asked, whether they would have Henry of Lancaster, or Edward, Duke of York, for their king? The multitude unanimously shouted, "a York!" Upon this, an assembly of bishops, lords, and other persons of distinction, was immediately called at Baynard Castle, which ratified the popular election, and the Duke was next day proclaimed in London by the name of Edward IV.

The new monarch was every way fitted, both by his talents and his dispositions, for the dangerous situation which he had to maintain. Bold and enterprising, vindictive and cruel, he was unawed by danger, and incapable of pity. He seemed to exult in scenes of slaughter and devastation; and, during his reign, the scaffold, as well as the field, incessantly streamed with the blood of England. The first act of his government gave symptoms of his savage disposition. A harmless tradesman, who kept a shop at the sign of the crown, had said, in a punning humour, that he would make his son heir to the crown, which gave such offence to the king, that the poor man paid for his wit with the loss of his head. But Edward was soon called to gratify his savage nature with nobler deeds of cruelty. Margaret, in a few weeks, had collected an army of 60,000 men among her partizans in the north, and was returning to the capital to strike her strongest blow. But she was met at Tounton by 40,000 Yorkists, under Edward and Warwick. Previous to the engagement, a body of Yorkists under Lord Fitzwalter, had been dispatched to secure the passage of the river Arre at Ferrybridge, but they were driven from their post with great slaughter by Lord Clifford, and their leader slain. The disaster at Ferrybridge was revenged by the defeat and death of Clifford by Lord Falconberg, who recovered that important post. This was immediately followed by a general battle, on the issue of which depended the fate of the contending factions. As the Queen's army advanced to the charge, they were blinded by a shower of snow, which blew full in their face; and Lord Falconberg, taking advantage of this circumstance, led out some infantry before the line, and, after discharging a volley of arrows, immediately retired. The Lancastrians imagining that they had come within reach of the opposite army, let fly all their arrows, which fell short of the enemy. Edward then advanced with his main body, and dealt such havoc among the dismayed Lancastrians, that they were totally defeated. As this prince had issued orders to give no quarter, the routed army was pursued with terrible slaughter, and 36,000 men, among which were some of the principal nobility, are computed to have fallen in the battle and pursuit. Margaret, with her son and husband, fled immediately to Scotland, and Edward proceeded to York. He took down, from the gates of that city, the heads of his father and the Earl of Salisbury, which he buried with their bodies, and put in their place the heads of the conquered generals.

On the return of the king to London, a parliament was assembled, which now, overawed by his success, no longer hesitated between the rival families, but immediately recognised his title, and confirmed his authority. They were also ready in their servility to second his revenge against his enemies; and they passed an act of forfeiture and attainder against Henry VII, his queen, and infant son. This act was extended to the principal nobility and gentry, that adhered to their cause, and their estates were vested in the crown. But though the victorious Edward had endeavouring to secure his elevation by the show of legal authority, and by the extirpation of his adversaries; there were many in the kingdom still warmly attached to the House of Lancaster. The Earl of Oxford and his son were detected in a correspondence with Margaret, were tried by martial law, and immediately executed. Sir William Tyrrel and some others suffered in the same arbitrary manner, and for the same crime. The rigours of the government, however, instead of reconciling the discontented to its authority, only increased their animosity, and the people soon discovered that they had exchanged a weak ruler for a tyrannical one.

The battle of Tounton had not extinguished the hopes of Margaret of Scotland. She had engaged the assistance of France and Scotland, by promising to the one the surrender of Calais, and to the other the delivery of the important fortress of Berwick, should her family be again restored to the throne of England. Thus supported, she resolved to make another effort against her enemies, and having received from Louis XII 3000 men as arms, was being farther reinforced by many of her own partizans, and a numerous train of Scottish adventurers, she made an inroad into England. Her ill-fortune, however, still attended her. Her forces received a check at Hedgeley moor, which was soon after followed by a complete defeat, near Hexham, by the Yorkists, under Lord Montague, brother to the Earl of Warwick, and warden of the East Marches. The Duke of Somerset, and the Lords Roos and Hungerford, were taken in the pursuit, and immediately executed. The unfortunate queen, flying with her son from the rage of her enemies, was bennighted in Hexham forest, and fell into the hands of robbers, who regardless, perhaps ignorant, of her quality, stripped her of her rings and jewels, and treated her with great indignity. She, however, found means to escape, while they were quarrelling about the spoil, and retired into the thickest of the wood. Overcome with terror and fatigue, she sunk down in despair, but was suddenly roused by the appearance of a robber, with his sword drawn. Seeing no way of escape, she resolved to trust to his mercy, and boldly advancing, she presented to him the young prince, "Here, my friend," said she, "I commit to your care the safety of your king's son." The man, surprised by the singularity of this adventure, and pleased with the confidence reposed in him, offered her his protection, and gave her every assistance in his power. By his means, she remained concealed for some time in the forest, and then made her escape beyond seas, to her father's court, where she lived for several years in privacy and retirement. Her husband was not so fortunate; for after lying concealed for about a year among his friends in Lancashire, he was discovered, and committed a prisoner to the Tower.

Edward being now firmly fixed upon the throne, and freed from all fears of danger from his enemies, gave loose reins to his libertine disposition, and indulged in all the dissipations and amusements of a luxurious court. His debaucheries and amours became so open and unrestrained, that Warwick, apprehensive that they might spread disaffection among his subjects, advised him to marry; and Edward, in order to give greater security to
his throne, had fixed upon Bona of Savoy, sister to the queen of France. By this alliance, he hoped to ensure the friendship of that power, which alone was able and inclined to give support and assistance to his rival, and he dispatched Warwick to demand Bona in marriage. The proposals were accepted, and the princess was ready to set out for England. But while Warwick was engaged in this negotiation, Edward had found a queen for himself.

Lady Elizabeth Gray, the widow of Sir John Gray of Groby, was remarkable for the grace and beauty of her person, as well as for other amiable accomplishments. Her husband, who was a Lancastrian, was slain in the second battle of St Albans, upon which his estate was confiscated, when his widow went to live with her father Sir Richard Woodville of Grafton. It was here the amorous monarch first beheld Lady Elizabeth, and after having vainly endeavoured to debauch her, he resolved to make her his queen. They were privately married at her father's seat; and when this was communicated to Warwick, that nobleman, deeming himself affronted, returned to England, filled with rage and discontent. Instead of endeavouring to pacify this powerful chief, to whom he owed his throne, Edward heightened his resentment by neglect, and the Earl retired in disgust from a court where his important services seemed to be entirely forgotten. The breach was farther widened by the partiality of kings to the family of Woodville. The queen's father was created Earl of Rivers, and invested with the office of constable for life, and three of her sisters were married to the Duke of Buckingham, and the Earls of Kent and Huntington. The haughty Warwick could not brook to see an upstart family so far surpass him in authority and influence with the king; and in this he was joined by the Duke of Clarence, Edward's brother, and many of the ancient nobility. The Earl's adherents were daily increased by his gracious and popular manners, and a dangerous combination was thus formed against Edward and his ministers.

The king saw the cloud as it was gathering; and in order to secure himself against its effects, entered into an alliance with Charles the Bold, Duke of Burgundy, to whom he gave his sister Margaret in marriage. He, at the same time, concluded a league with the Duke of Burgundy, by which these connections, not only strengthened his power at home, but also enhanced his prospect of foreign conquests. But intestine commotions prevented him from giving disturbance to his neighbours, and confined his attention to more immediate objects. The popular discontent first broke out in Yorkshire, where the inhabitants, complaining of the oppressions which were exercised upon them, in collecting the revenue of St Leonard's hospital, rose in arms, and advanced to the gates of York, in a body of 15,000 strong. They were opposed by Lord Montague, who, having seized Robert Hudlerne his leader, ordered him to be immediately executed. But being afterwards headed by Sir Henry Nevil, and Sir John Coniers, they advanced southward, and their numbers daily increased. The Earl of Pembroke was sent against them with a body of Welsmen, and being joined by the Earl of Devonshire, with 5000 archers, they approached the rebels near Banbury. Sir Henry Nevil was taken prisoner in a skirmish, and put to death; which so enraged his followers, that they fell upon the royalists, routed them with great slaughter, and having seized Pembroke, revenged upon him the death of their leader. This disaster was imputed to the Earl of Devonshire, who, in a quarrel with Pembroke, had retired with his archers before the battle; and the king punished his desertion with death. A part of the rebels then seized the Earl of Rivers, and his son John, at Grafton; and as these noblemen had become objects of envy and dislike, by their sudden exaltation, they were put to death by the orders of Sir John Coniers. The rebels, however, were soon after quieted and dispersed, upon receiving a general pardon.

It does not appear that Warwick or his party were concerned in this insurrection. At the commencement of it he was absent in his government at Calais, and his brother Montague had assisted in repressing it. In another rebellion, however, which soon followed, he took a more active part; and though, perhaps, its origin cannot be justly imputed to him, yet he afterwards encouraged it by his countenance and assistance. It arose in Lincolnshire, and was headed by Sir Robert Welles. The rebels amounted to 30,000 men, and Edward, who entertained no suspicions of the fidelity of Warwick and Clarence, sent these noblemen to raise forces to oppose them; but as soon as they left the court, they levied men in their own name, and issued complaints against the government. In the mean time, however, the king had defeated the rebels, and put their leader to death, which so disconcerted Warwick's measures, that he retired northward, expecting to be joined by his brother Montague, and Lord Stanley, who had married his sister. But these noblemen refused their assistance, and Warwick and Clarence were obliged to disband their troops, and embark for Calais. But the deputy governor, whom the Earl had left in that fortress, seeing him return a fugitive and exile, refused him admittance, upon which he seized some Flemish vessels which were lying off Calais, and proceeded to France.

Louis, whose ambition led him to take every opportunity of giving disturbance to his neighbours, received the banished Warwick with every demonstration of respect, and by his intrigues and promises, brought about a reconciliation between that Earl and his former enemy Margaret of Anjou. The rancorous hatred which had long subsisted between the parties, was overcome by the present distresses of both. Forgetting their former animosity, they now united from common interest; and Louis prepared a fleet to assist them in the possession of England.

But the Duke of Burgundy, enraged at the seizure of his vessels before Calais, had fitted out a superior fleet, in order to intercept Warwick, and had sent information to the king of England of the designs of his enemies. Edward disregarding this intelligence, made no preparation against the threatened danger. He even vauntingly said to Burgundy, that he might spare himself the trouble of watching the enemy, as he wished for nothing more than to see Warwick in England. Edward, in the mean time, had entered into a secret correspondence with his brother Clarence, who promised, on a favourable opportunity, to abandon the cause of Warwick. This act of treachery, however, was balanced on the other side, by the Marquis of Montague, who was in the confidence of Edward, and who engaged, in a similar manner, to turn his arms against his sovereign.

While Edward was engaged in suppressing a rebellion in the north, Warwick, having escaped the Flemish navy, which had been dispersed in a storm, landed at Dartmouth with a small body of troops. His great popularity, however, and the zeal of the Lancastrian party, which had been crushed but not extinguished, drew...
such numbers to his standard, that, in a few days, his army was swelled to 60,000 men. Edward hastened southward to oppose him, and the hostile armies met near Nottingham. The rapidity of Warwick’s march had prevented Clarence from executing his intentions in favour of Edward, and Montague was the first to betray his trust. Having secured his adherents, Montague took arms in the night, and hastened to the king’s quarters.

Edward, alarmed at the Lancastrian cry of war, started from his bed, and being informed of his danger by Lord Hastings, who urged him to make his escape, he fled with a small retinue to Lyne, in Norfolk, where he embarked, and landed in Holland. Such was the precipitation with which he left England, that he had carried nothing of value along with him, and could only reward the captain of the vessel with a robe lined with sables.

The flight of Edward left the kingdom entirely at Warwick’s disposal. That nobleman hastened to London; and summoning a parliament at Westminster, the unfortunate Henry was released from prison, and restored to his throne. Being declared, however, incapable of governing, Warwick and Clarence were entrusted with the regency during the minority of young Edward; and, in failure of that prince’s issue, Clarence was appointed successor to the crown. Many of the Yorkists fled beyond seas, others concealed themselves in London, and the Earl of Worcester was the only nobleman that suffered upon the restoration. But the triumph of the Lancastrians was of short duration, and they were soon compelled in their turn to seek for refuge and protection from the fury of Edward.

The Duke of Burgundy had endeavoured to conciliate the friendship of the reigning party, by refusing all succours to his brother-in-law; but, finding that Warwick had engaged in an alliance with the King of France, and had even sent over 4000 troops to Calais to make inroads into his territories, he resolved to assist Edward in recovering the crown of England. He secretly equipped a small squadron in the ports of Zeeland, in which, with 2000 men, Edward, after an absence of nine months, proceeded to England to try his fortune in the field of war. He landed at Ravenspur in Yorkshire; but, being coldly received, he pretended that he came not to disturb the peace of the kingdom, but merely to claim the inheritance of the house of York. When the adherents of his party flocked to him from all quarters, Warwick having assembled an army at Leicester, hastened to give him battle; but Edward, taking another road, passed him unmolested, and presented himself before the gates of London. Here he was admitted without hesitation, and was even joined by the Archbishop of York, Warwick’s brother. The feeble Warwick was again taken from his throne, and carried back to his old prison in the Tower. Finding himself now in a condition to face the enemy, Edward met Warwick at Barnet, in the neighbourhood of the capital. Warwick had been reinforced by his son-in-law the Duke of Clarence, and his brother the Marquis of Montague; but the former deserted to his brother Edward during the night with 12,000 men. This, however, did not discourage the brave Warwick. He had advanced too far to retreat; and, dismissing all the terms offered him by the enemy, he resolved to stake his fortune upon the issue of a battle. The engagement began early in the morning. The two most renowned generals of the age headed the contending armies, and their example inspired their followers with more than ordinary valour. Victory or death seemed to be the only alternative that was left them; and the battle continued long unabated and doubtful. But owing to a slight mist, the army of Warwick having mistaken a party of their friends for the enemy, fell upon them with such fury, that they drove them off the field. This error turned the fortune of the day; and Warwick having in vain attempted to retrieve the mistake, at last resolved to sell his life as dear as possible, and rushing into the thickest of the enemy, fell covered with wounds. His brother Montague perished with him; and as orders had been given by Edward to give no quarter, the slaughter was dreadful.

On this fatal day, Queen Margaret and the Prince of Wales landed with a small body of French forces; but, instead of meeting with the congratulations which she expected, she was confounded by the intelligence of the death of Warwick, and the captivity of her husband. Her magnanimity, which had formerly supported her under so many trials and disasters, now failed her; and foreseeing the dismal consequences of so fatal a reverse, she took sanctuary in the abbey of Beaumieu. Here, however, her spirits were revived, by the appearance of the Earl of Pembroke, the Duke of Somerset, and other powerful barons, who exhorted her still to hope for success, and offered her their lives and fortunes to support the cause of her family. Yielding to their encouragements, and flattered with the prospect of regaining her authority, she advanced into the heart of the kingdom, while Pembroke went to levy forces in Wales. Her army daily increased as she proceeded; but the determined Edward overtook her at Tewksbury. The Duke of Somerset, a man of valour and abilities, but rash and impetuous, commanded the Lancastrians. He repulsed the first attack of Edward with such vigour, that the Yorkists retired with precipitation; and following up his success, he ordered Lord Wenlock to support him in the charge. But Wenlock disobeyed his commands; and Somerset was overpowered by numbers. Enraged at his loss, and transported with fury at beholding Wenlock still inactive, he ran up to the coward, and with one stroke of his battle-axe dashed out his brains.

About 5000 were slain on the side of the Lancastrians, and Margaret and the Prince of Wales fell into the hands of the victors. Somerset, and about twenty persons of distinction, having taken refuge in a church, were dragged thence, and immediately beheaded. Pembroke, when he heard of the defeat of his friends at Tewksbury, disbanded the troops which he had collected, and fled into Brittany with his nephew, the young Earl of Richmond. When Margaret and her son were brought to Edward, that monarch insultingly demanded of the young prince, how he dared to invade his dominions. That noble youth, then about eighteen years of age, appeared undaunted by the presence of his victorious enemy; but, unmindful of his situation, he boldly replied: “I have entered the dominions of my father, to revenge his injuries, and to redress my own.” Thebarbarous Edward, enraged at his intrepid spirit, struck him on the face with his gauntlet; and his brothers, the Dukes of Clarence and Gloucester, with Lord Hastings and Sir Thomas Gray, taking this as a signal for his death, hurried him into the next apartment, and dispatched him with their daggers. This tragedy was followed by the death of King Henry, who died a few days after in confinement; but it was generally believed, that he was murdered in cold blood by the hand of Gloucester. Margaret was thrown in-

Arrival of Queen Mar-
garet.

Edward is defeated at Tewks-
burv.

And taken prisoner.

Death of Henry VI.
to the Tower; but was ransomed for 50,000 crowns by Louis XI. and died some years after in France, forgotten and neglected.

The principal leaders of the Lancastrian party having perished in the field or on the scaffold, Edward continued to glut his vengeance, by the execution of their meaner adherents; and the gibbet soon finished what the sword had begun. But this relentless monarch, even while his hands were bathed in blood, was immersed in voluptuous pleasures and amusements. He was universally allowed to be the most beautiful man of his time; and his debaucheries, which were open and numerous, were encouraged and imitated by a profligate court. All ranks seemed willing to forget the dismal scenes that were past in the less dangerous exploits of gallantry and intrigue. But the king was roused from his inactivity, by the call of the Duke of Burgundy to unite their arms against France.

A French war was always a popular measure with the English parliament; and they readily granted him a considerable supply, which he increased by levying a benevolence. He then passed over to Calais with 1500 men at arms, and 15,000 archers, attended by his principal nobility. But, instead of being joined by the forces of Burgundy, as he had expected, the Duke was spending his strength on the frontiers of Germany, and against the Duke of Lorraine. This disappointment led Edward to listen to the advances of the French monarch, who, alarmed at the prospect of such a formidable invasion, attempted to avert the danger by negotiation, and to detach him from the alliance of Burgundy. When the King of England dispatched a herald to Louis, to claim the crown of France, and to carry him a defiance in case of refusal, Louis, instead of being irritated by the insult, replied with great moderation, and even gave the herald a considerable present. Louis had also requested the good offices of Lords Stanley and Howard to second his desires for peace; and Edward was soon after brought to conclude a truce, more to the advantage than the honour of Louis. That monarch stipulated to pay 75,000 crowns, upon condition of Edward's withdrawing his army from France; and 50,000 crowns a year during their joint lives. It was also agreed, that the dauphin, when of age, should marry Edward's eldest daughter. The two monarchs had afterwards a private conference at Pequigny, near Amiens, where they interchanged mutual civilities, and confirmed their friendship.

Edvard returned to England, after this fruitless expedition, only to disgust his subjects by his profligacy and cruelty. The Duke of Clarence, since his alliance with the Earl of Warwick, notwithstanding his after services, in assisting him to recover the crown, had never been able to regain the confidence of his brother. His open and hasty temper had also multiplied his enemies, among whom were the queen and his brother the Duke of Gloucester, who united in hastening his destruction. Irritated by the indifference with which he was treated at court, he did not hesitate to express his dissatisfaction, and sometimes indulged in ill-natured invectives. His enemies took advantage of his resentment; and endeavoured to stimulate him to still further resistance, by the persecution of his friends. Thomas Burdet of Arrow, who happened to live in intimacy with the duke, had a favourite buck killed by the king, while hunting in the park of the owner; which so vexed Burdet, that, in a hasty humour, he wished the horns of the deer in the belly of the person who advised the king to do him such an injury. For this ex-
Gloucester, who, by the most profound dissimulation, had been able to conceal a heart deformed by every thing that was mean, cruel, or base, had hitherto lived on good terms with both factions. But as his immediate ambition led him now to look towards the crown, he resolved to attach himself only to those, from whom he might expect least opposition to his views. At the same time, however, he assiduously paid court to the Queen, by professing the greatest zeal and attachment to her family; and thus gained such credit with her, that she for a time trusted implicitly to the sincerity of his friendship.

Young Edward had been committed to the care of his uncle, the Earl of Rivers, the most accomplished nobleman in England, and resided in Ludlow castle, on the borders of Wales. The Queen, desirous of retaining him in her power, wrote to her brother to levy a body of troops, in order to escort the young king to London, and to prevent him from falling into the hands of his enemies. This measure gave great offence to the opposite faction, who, apprehensive of being reduced to subjection by their rivals, declared their resolution of resisting force by force. The wily Gloucester, interposing his authority, and, under pretence of pacifying the dispute, prevailed upon the Queen to bring up no greater retinue than should be necessary to support the state and dignity of the new sovereign. But he himself set out from York, attended by a numerous train of the northern gentry; and at Northampton, was joined by Buckingham with a splendid retinue. Here they waited the approach of the king. Rivers, however, apprehensive that the place would be too small for all their attendants, had sent his charge forward to Stony-Stratford, and came in person to pay his respects to the Regent. He was received with seeming cordiality and friendship; and they all proceeded next day to join their sovereign. But when they were entering Stony-Stratford, Rivers was arrested by order of the Regent, and with Sir Richard Gray, one of the Queen's sons, and Sir Thomas Vaughan, an officer in the king's household, was sent a prisoner to Pontefract castle. Gloucester endeavoured to satisfy the young king with respect to the violence against his relations, but his wishes were unable to dissemble his disappointment and displeasure.

When the queen heard of the fate of her brother, she foresaw that the ruin of herself and family was determined, and took sanctuary with her family in Westminster Abbey. Gloucester now used all his arts to get the Duke of York into his power; but his mother resisted all his solicitations: the council, however, threatened to employ force if she continued obstinate; which induced her to comply. When she took leave of her son, she bade him with her tears, and, as if struck with a presage of his future fate, bade him an eternal adieu. Gloucester then took his nephew in his arms, and, clasping him with feigned affection, declared, that while he lived, the boy should never want a parent. But the hypocritical tyrant was all the while meditating the most bloody designs against the helpless innocent.

Having thus got into his power the principal obstacles to his ambition, Gloucester prepared for more treacherous and bloody deeds. As he was the nearest male of the royal line capable of exercising the government, he was invested by the council with the office of protector, without waiting for the consent of parliament; and the first use he made of his high dignity, was to order the death of Rivers, and the other prisoners in Pontefract Castle. To this tyrannical and sanguinary measure Buckingham and Hastings gave their consent; and the prisoners were beheaded without any form of trial. He next summoned Buckingham respecting his usurpation of the crown; and prevailed upon him, by liberal offers of private advantages, to support him in all his measures. The loyalty of Hastings, however, was proof against every promise and persuasion; and that nobleman determined to maintain unshaken his allegiance and fidelity to the children of Edward. As the tyrant, therefore, dispised of gaining him to his interest, he resolved upon his death. With this design he summoned a council in the Tower. The protector appeared with a cheerful countenance, and, before they entered upon business, conversed with the members with great affability and good humour. He then left the council, as if called away in haste; and in about an hour after returned, but with quite an altered look; his brows knit, and his countenance inclined with rage. Those who knew his savage nature beheld him with horror, expecting some dreadful catastrophe. After a short silence, he asked them, what punishment they deserved who had conspired against his life. Hastings replied, that they desired the punishment of traitors. "See, then," cried the protector, baring his withered arm, "what the sorceress, my queen-sister, and that wretch, Shore's wife, have done by their incantations and witchcrafts; their spells have reduced my arm to this condition; and had they not been timely detected, my whole body would have suffered the same calamity." The council gazed upon one another in much astonishment, knowing that this infirmity had attended him from his infancy; and the silence was again broken by Hastings, who said, "If they have been guilty of these crimes, they merit the severest punishment." "If!" cried Gloucester in a rage; "do you reply to me with your ifs? you are yourself a traitor, and the chief abettor of that witch, Shore; and I swear by St Paul, that I will not dine before your head be brought me." He then struck the table with his hand, and the room was instantly filled with armed men. The council room was now filled with tumult, and one of the guards aimed a blow with his battle-axe at Lord Stanley's head, which the fellow, in all likelihood, had been instructed to do; but that nobleman escaped by shrinking under the table. Hastings was seized, and immediately beheaded on a log of wood which happened to lie in the court of the Tower. Lord Stanley, the Archbishop of York, the Bishop of Ely, and some other counsellors, were afterwards committed prisoners to the Tower; and a proclamation was read to the citizens of London, among whom Hastings was very popular, enumerating his offences, and apologising for his sudden execution, by the suddenness of the discovery. In order to carry on the farce, he ordered Jane Shore to be tried for witchcraft; but as no evidence was produced against her, she was accused of adultery before the spiritual court, and condemned to walk barefoot through the city, and to do penance in St Paul's church in a white sheet, before all the people. This unhappy woman languished out her life in solitude and indignity, neglected and unpitied by those who had formerly been protected by her credit, and had lived upon her bounty.

After the murder of Hastings, Gloucester proceeded openly in his ambitious designs. He endeavoured, by means of Buckingham, to instil into the minds of the people an opinion of the illegitimacy of the late king and his children. He thus had the impertinence to charge his
The Duke of Buckingham was next appointed to harangue an assembly of the citizens, to whom he enumerated the calamities of the preceding reign, and the many virtues of the protector; and endeavoured to convince them of the illegitimacy of the present king. He then asked them whether they would have a bastard prince, or the virtuous protector for their sovereign; but no one answered him. He treated them to speak out their real sentiments, and give him a positive answer; when some of his own servants, who had slipped among the crowd, cried out, "God save King Richard!" which was seconded by a few of the citizens, who had been previously bribed. This feeble cry was interpreted as the voice of the nation; and Buckingham, with the mayor and aldermen, immediately hastened to Baynard's castle, where the Protector then resided, to make him an offer of the crown.

Gloucester, who was a complete master in dissimulation, affected to be surprised at the appearance of Buckingham; and when informed of his intentions, he refused the offer of the crown, and declared his purpose of maintaining his loyalty to the present sovereign. Buckingham appeared displeased with his answers, and told him, that, as the nation were determined to have another king, if he resisted their unanimous wish, they must fix upon some other person who would be more compliant. "I see," cried the Protector with the most hypocritical humility, "that the nation is resolved to load me with pre- ferments unequal to my abilities or my choice; and I graciously accept their petition."

Richard had no sooner obtained the crown, than he resolved to secure it by the death of his nephews; and he gave orders to that purpose to Sir Robert Brakenbury, constable of the Tower. But that gentleman refused to be the instrument of his cruelty. Brakenbury was then commanded to resign the government of the Tower for one night; Sir James Lyric, who, with three associates, Slater, Digton, and Forest, soon accomplished the bloody purposes of the tyrant. They entered the young princes' chamber while they were fast asleep, and suffocated them with the bolster and pillows. They then buried their bodies deep in the ground under the staircase. Their bones were afterwards discovered in the reign of Charles II. and interred under a marble monument in Westminster Abbey.

Richard employed his new acquired authority, in bestowing rewards and preferments upon those who had assisted in his exaltation, and who were best able to support his government. He created Thomas Lord Howard, Duke of Norfolk, and Sir Thomas Howard, his son, Earl of Surrey. He also set Lord Stanley at liberty, and made him Steward of the Household. Buckingham, the chief promoter of his ambition, was loaded with dignity and honours. He was invested with the office of Constable, and received a grant of the estate of Hereford, one of the greatest of the ancient baronies. But while Richard was thus endeavouuring to strengthen his ill-gotten power, he was hated and feared by every man of sense and virtue in the kingdom; and the very accomplices of his crimes were contemplating his overthrow.

The Duke of Buckingham himself soon became disgusted with the new government; but whether this arose from his own restless and turbulent disposition, or from any part of the king's conduct towards him, is not known. It was only, however, a few months after Richard's accession, when this nobleman began to form a conspiracy against him, and to attempt to pull him from the throne, to which he had been so instrumental in raising him. For this purpose he cast his eye towards the young Earl of Richmond, who was the only remaining branch of the house of Lancaster, and who seemed the only person that could free the nation from the tyranny of the usurper. He was encouraged in these sentiments by Morton, Bishop of Ely, a zealous Lancastrian, who had been imprisoned by the king, but who had afterwards been committed to the custody of Buckingham.

Henry Earl of Richmond had been carried into Britain by his uncle, the Earl of Pembroke, immediately after the battle of Tewksbury; and had been detained there in a kind of honourable custody by the reigning duke, at that time the ally of England. Edward IV. after his restoration, had frequently endeavoured to prevail upon his ally, who was a weak but good prince, to deliver the young Earl into his power; and had at last so far succeeded, under a pretence of marrying him to his eldest daughter, that Henry was put into the hands of the English ambassadors, and was on ship-board, when the Duke, suspicious of Edward's real design, recalled his orders, and saved Richmond from destruction. This continued jealousy of Richmond's pretensions to the crown, tended to confirm them in the minds of the people; and the universal detestation in which Richard was held, turned the attention of the nation towards that nobleman. But, in order to unite all parties in a cause which promised to contribute so much to the happiness of the kingdom, by the expulsion of the odious tyrant, Morton suggested the project of uniting the opposite factions, by the marriage of Richmond with the Princess Elizabeth, the eldest daughter of King Edward. This scheme was communicated to the Earl, and also to the queen-dowager. Both entered heartily into the designs of Buckingham. The Queen borrowed a sum of money, and sent it over to Richmond; required him to join and celebrate the marriage on his arrival in England; and promised to join him with all the friends and partizans of the family. But their intention did not escape the vigilant eye of Richard; and Buckingham was suspected of being concerned in the conspiracy. The King resolved to send for the Duke of Buckingham, in order to discover if his suspicions were well founded; but the Duke, well knowing his barbarity and treachery, only answered by taking up arms in Wales, and calling upon his associates every where to join him. But the swelling of the Severn prevented him from marching into England; and detained him so long, that his army, distressed for want of provisions, fell off from him, and left him almost without a follower. In this helpless situation, he put on the disguise of a peasant,
and took shelter in the house of one Bannister, an old servant of his family. A large reward, however, was set upon his head; and the villain Bannister, unable to resist the temptation, betrayed his master; when he was brought to the king at Shrewsbury, and instantly executed. The other conspirators, who had risen in different parts of the kingdom, as soon as they heard of his fate, immediately dispersed. The Marquis of Dorset and the Bishop of Ely fled beyond sea; some of their friends fell into the hands of Richard and were executed, and others contrived to conceal themselves from his vengeance. The Earl of Richmond, in the mean time, had arrived off the coast of England with 5000 troops; but hearing of the dispersion of his friends, he returned to Britany.

Richard, emboldened by his success, now ventured for the first time to call a parliament, which acquiesced in whatever he chose to propose. They approved all his proceedings; confirmed the illegitimacy of Edward's children; attainted the Earl of Richmond and all his adherents; and granted the king the duties of tonnage and poundage for life. He next entered into a negotiation with the Duke ofBritany for delivering up his rival, and had nearly succeeded, through the treachery of Peter Landsais, a corrupt minister of that court, when Richmond, having got timely notice, fled into France. Richard, however, still continued to employ every mean that might give security to his throne; and sensible that his rival was only formidable from his projected marriage with the Princess Elizabeth, the true heir to the crown, he formed the design of espousing that princess himself. He had married Anne, the second daughter of the Earl of Warwick, and the widow of Edward, Prince of Wales, whom he himself had murdered. But, considering her as an invincible obstacle to his designs, he is believed to have carried her off by poison. He then made application to his niece, and paid court to the queen-dowager with such art and address, that thus princess, eager to recover her lost authority, did not scruple to give her consent to this incestuous alliance, and to marry her daughter to the murderer of her three sons and her brother: She even so far joined her interests with those of the usurper, as to desire her son, the Marquis of Dorset, and all her partizans, to withdraw from the Earl of Richmond. But the young princess disdain'd to listen to his vile passion, and treated his addresses with contempt and detestation. While Richard was thrown into perplexity by her unexpected refusal, and before he had time to renew his suite, the Earl of Richmond landed at Milford-haven with a small army of 2000 men. As he advanced, his friends flocked to his standard; but his army, with all his reinforcements, amounted only to 6000 combatants. Richard met him at Bosworth, near Leicester, with a force double the number. This superiority of numbers, however, was rendered of little advantage, by the dissensions which prevailed among them. Lord Stanley had been suspected by Richard of favouring the cause of Henry; and when he empowered him to levy troops, detained his eldest son Lord Strange as a pledge for his fidelity. That nobleman was thus prevented from openly declaring himself, though he had sent secret assurances to Henry of his friendly intentions, and, at the head of 7000 men, posted himself on the flank of the two hostile armies, ready to join either party as occasion should offer. Richard, apprehensive of his design, sent him orders to join him, which Stanley refused; upon which the tyrant was about to take revenge upon his son, but he was persuaded to postpone the execution till after the fight, when, being certain of a victory, he would take ample vengeance upon all his enemies, both open and concealed. The trumpets were then ordered to sound to battle, which began by a flight of arrows; but the ranks soon began to close, when Stanley advanced, and joined the army of Richmond. This circumstance turned the fortune of the day. It inspired Henry's soldiers with unusual courage, while it spread dismay and confusion among Richard's. Richard, enraged to madness by the treachery of Stanley, and sensible of his desperate situation, resolved to finish the battle, either by Henry's death or his own. He rushed into the thickest of the fight, and flew from rank to rank in search of his rival. Richmond himself did not decline the combat; but when they were just within reach of each other, they were separated by the crowd. Richard perceiving his men every where yielding and flying, and giving up all for lost, spurred his horse into the midst of the enemy, and fell covered with slain. His body was found in the field of battle, in the midst of dead enemies, and disfigured with wounds. It was thrown across a horse, and carried to Leicester, where it was interred in the Gray Friars Church. Thus perished Richard III., who waded to the throne through the blood of his nearest relations; who considered no enmity too great, and no action too mean, provided it led him to the object of his ambition. He enjoyed his exaltation little more than two years; and perished by a fate too mild and honourable for his multiplied and detestable crimes. He was of a small stature, hump-backed, with a harsh disagreeable countenance, so that his body and his mind were equally deformed. (?)

The decisive victory gained at Bosworth, was followed by the most important consequences. An ornamental crown, which Richard had worn in battle, having been found among the spoils, was placed upon the head of Richmond; and the whole army, as by one instantaneous movement, shouted aloud, "Long live Henry VII." His title, indeed, to the crown, was in many respects defective. The hereditary right resided in the house of York, of which there were several princes then alive. His own descent from the house of Lancaster proceeded from an illegitimate branch, and though an act of legislation had been passed in the reign of Richard II. yet the very patent which conferred the privilege, excluded the posterity of that line from the crown. But the Lancastrian party had resolved to adopt him as their head; and his solemn engagement to marry the Princess Elizabeth, the representative of the house of York, attached the adherents of that family to his cause. To the expectation of this union he owed much of his past success, and it was hailed by all considerate men as the probable termination of those civil wars, which had raged for thirty years with such destructive violence. He did not, however, deem it expedient to engraft his title upon that of the rival house, but being in possession of the power, he advanced his claim as the heir of Lancaster, while he resolved to prevent the discussion of its validity.

Having refreshed his army a few days at Leicester, he proceeded slowly towards the capital, and at every step of his progress was saluted with the loudest acclamations. He was received by the citizens of London with every expression of satisfaction and respect; but seeming to court popularity, he entered the city in a close chariot, and refused to gratify the people with a sight of their new sovereign. Proceeding directly to St Paul's, he deposited the standards which had been taken at Bosworth, and returned thanks to God for the victory. He hastened to re-
new in public his promise to espouse the Princess Eliza-
Beth; but that he might not seem to derive his claim
from her right, or to depend upon her life for the dura-
tion of his authority, he determined to postpone the alli-
ance till his own coronation should be finished, and his
title recognised by parliament. He was crowned king of
England on the 20th of October 1485, with the usual
pomp and ceremonies; and, to heighten the splendour
of the spectacle, he bestowed the rank of knights banneret
on twelve persons, and conferred peerages on three.

When the parliament assembled in the beginning of
the following month, it was found that many members
of the House of Commons, who were his most zealous
partisans, had been attained in the preceding reign.
These persons he required to abstain from taking their
seats, till an act should be passed to reverse their attain-
der, and thus exhibited a degree of regard to the laws hi-
thero unknown in England. The same parliament,
however, granted the king's ressentment towards the ad-
herents of the York family, by passing an act of attain-
der against the Duke of Norfolk, and thirty other per-
sons who had fought under Richard at Bosworth,—a
measure which could only have been prompted by ava-
rice or revenge, and which excited considerable de-
bates in the House, as well as murmuring among the peo-
ple. At the same time, Henry issued a royal procla-
amation, offering pardon to all who had taken part against
him, upon condition that they submitted by a certain
day, and took the usual oath of allegiance.

Perceiving that the delay of his marriage rendered the
nation more suspicious of his proceedings, and having
been petitioned by parliament to fulfil the wishes of his
people, he espoused the Princess Elizabeth on the 15th of January 1486. The public rejoicings on this occasion,
were greatly superior to those which had taken place at
his own accession and coronation; a circumstance which
Henry regarded with jealously displeasure, as the testimo-
y of general favour to the house of York, and which
gave rise to suspicions in his mind subversive at once of
his own tranquillity, and of that tenderness which he ow-
ed to his amiable consort. Having taken due care to
prolong the continuance of peace abroad, particularly
with the kingdoms of France and of Scotland, he resol-
ved to secure more effectually the internal quiet of his
own dominions. In this view, he set out on a journey
to the northern districts, where the friends of the late
king and of the house of York were most numerous, in
the hope of either swining the malcontents by his pre-

dence, or conciliating them by his censure.

Upon his arrival at York, he received intelligence that
Lord Lovel was approaching at the head of three or four
thousand men, and that Sir Humphrey and Thomas
Stafford had marched with another army to besiege the
city of Worcester. Though in the midst of disaffected
counties, Henry found resources in his own active cou-
rage, and having hastily collected a small body of troops,
he gave the command to his uncle the Duke of Bedford,
with orders, when he approached the rebels, to publish a
general promise of pardon to all who should lay down
their arms. Lovel, dreading the desertion which this
proclamation might produce among his troops, suddenly
withdrew in the night, and made his escape to Flanders.
His army submitted to the king's clemency; and the
other insurgents, intimidated by the surrender of their
confederates, instantly dispersed. The two Staffords
having sought refuge in some obscure church, which had
not sufficient privileges to protect them, were dragged
from the altar, and Humphrey, the elder, was executed
at Tyburn, but the younger, upon the plea of his youth,
received a pardon.

This success was followed by the birth of a son, to
whom Henry gave the name of Arthur, in memory of the
celebrated British king of that name, from whom the
house of Tudor was held to be descended. But neither
the recent triumph over his enemies, nor the acquisition
of a prince, who united all the claims of York and Lan-
caster, could reconcile the hearts of the English to their
sovereign. By a long course of civil war, the people
were become so turbulent and factious, that no king could
please them; and this rooted disposition to insurrection,
was still farther inflamed by Henry's open animosity to
the house of York. The undisguised preference which
he gave on all occasions to the Lancastrians; his frequent
acts of severity against the opposite party; his reported
harsh treatment of the Queen; his refusing her, even
after the birth of a son, the honour of a public coron-
ation; his imprisonment of the young Earl of Warwick
in the Tower; and his own reserved and haughty address,
all conveyed the idea that his prepossessions against the
Yorkists were inveterate, and contributed to render his
government generally unpopular.

In the midst of these discontents, a report was propa-
gated among the people, that Richard Duke of York,
second son of Edward IV. had saved himself from the
cruelty of his uncle Richard III. and was concealed
somewhere in England. This story was received with
great avidity, and suggested to a priest in Oxford, named
Richard Simon, the scheme of raising, upon this ground,
a pretender to the crown. Aided and advised, as has
been generally supposed, by some persons of higher rank,
he fixed upon a youth called Lambert Simnel, about fif-
teen years of age, who was the son of a baker, but who
possessed an understanding and address above his con-
dition, and whom he instructed to personate the son of
Edward, who was now rumoured to be alive. Hearing,
however, a new report, that the young Earl of Warwick
had made his escape from the Tower, and observing that
this was a subject of equally general satisfaction, he chan-
ged the plan of his imposture, and taught Simnel to re-
present that unfortunate prince. Sensible at the same
time that the counterfeit could not stand a very close
inspection, he carried his puppet to Ireland, as the most
proper theatre for opening the scene. In this country,
the people were all devoted to the family of York; and
the whole officers of state appointed in the preceding
regime, had been improvidently allowed to retain their au-
thority. Here the pretender experienced the most fa-
vourable reception from persons of the highest rank,
whose example was eagerly followed by the lower orders;
and Simnel, having been proclaimed king of Ireland,
was lodged with great pomp in the castle of Dublin.

Henry, alarmed by so unexpected a resolution, was at
first inclined to face his enemies in person; but suspect-
ing the conspiracy to have been framed in England, he
directed his own exertions to the discovery of its promo-
ters in that kingdom; while at the same time he did not
fail to provide the most rigorous means of suppressing
the revolt in Ireland. After frequent consultations with
his confidential friends, he commanded the queen-dow-
ger to be seized, and closely confined in the nunery of
Bermondsey; but, unwilling to charge so near a relative
with treason, he assigned, as the cause of this severe-
treatment, her having formerly delivered the Princess Elizabeth and her other daughters into the hands of the late king. He next ordered Warwick to be taken from the Tower, and led through the streets of London in the view of the whole people, directing at the same time several persons of rank, who were attached to the house of York, and well acquainted with the person of the young prince, to approach him, and converse with him. This expedient had the effect of exposing the imposture to his subjects in England; but the people of Ireland still persisted in their rebellion, and charged the King with having exhibited a counterfeit Warwick. John Earl of Lincoln, nephew of Edward IV, who had previously retired to Flanders, being there joined by Lord Lovel, and furnished by the Duchess of Burgundy with 2000 veteran Germans, under the command of Martin Swart, a brave and experienced officer, joined the party of Simnel in Ireland. The Irish, encouraged by this reinforcement, and having first crowned the impostor with great solemnity, proceeded to the invasion of England; and having landed in Lancashire, where they were received by Sir Thomas Broughton, a gentleman of considerable influence in that county; they advanced into Yorkshire, in the expectation of being joined by the inhabitants on their march. But the people in general, convinced of Lambert's imposture, averse to unite with foreign invaders, and awed by the reputation of Henry, either remained in tranquillity, or repaired to the royal army. Lincoln, who commanded the rebels, and whose force amounted to 8000 men, perceiving no hopes but in victory, resolved to bring the matter to a speedy decision. The king, who, upon the news of Simnel's landing, had advanced as far as Coventry, was equally eager for the combat. The hostile armies met at Stoke, near Newark in Nottingham, and, after an obstinate engagement, Henry obtained a complete victory, at the expence of 2000 of his best troops. Lincoln, Lovel, Broughton, Swart, and most of the rebel leaders, with 4000 of their followers, perished in the field of battle. The impostor Simnel, and his tutor Simon, were taken prisoners. The latter being exempted, as a priest, from the power of the civil law, was committed to close custody for life; and the former, being too contemptible an object for the resentment of Henry, was made, first, a scullion in his kitchen, and afterwards advanced to the office of a falconer. Few of the other delinquents were put to death, but many of them were subjected to heavy fines. The proceedings against all who were suspected of having favoured the rebels were sufficiently arbitrary and rigorous; but, on the other hand, the people were gratified, and the principal source of their disaffection removed, by the ceremony of the queen's coronation, which took place on the 25th of November 1487.

Henry, aware of the futility of conquests upon the continent, or, as some authors represent the matter, avverse, through motives of frugality; from all distant expeditions, found it nevertheless necessary, to gratify the warlike temper of his subjects, and to indulge their ancient animosity towards France, by professing a resolution to resist the encroachments which that rival power had recently made upon the province of Brittany. Having summoned a parliament at Westminster, he found no difficulty in persuading them to grant him a considerable subsidy; but, in those days, money was more easily voted than levied in England. The inhabitants of the more northern counties, who had been always disaffected to Henry's government, and who still smarted from his severities after the overthrow of Simnel, resisted the collection of the tax, and put to death the Earl of Northumberland, while he attempted to enforce obedience to the laws. Conceiving themselves too deep in guilt to escape, they proceeded to open rebellion; and, at the instigation of John a Chambré, a sedulous fellow of low birth, they chose Sir John Egremont as their leader, and declared against the king as a tyrant and usurper. As soon as Henry received intelligence of this insurrection, he dispatched a body of troops, under the Earl of Surrey, who dispersed the rebels without much difficulty; and a Chambré, having been taken prisoner, was executed at York, with twelve of his accomplices. Egremont fled for protection to the Duchess of Burgundy; and the greater part of his misguided followers received a pardon.

Henry, disappointed in his wishes to terminate the dispute with France by negociations, found himself under a necessity of adopting more active measures than he had intended; and the distresses of the Bretons became so urgent, that at length, (after receiving possession of two sea port towns from his ally, as security for the payment of his charges,) he sent 6000 men, for ten months, to resist the progress of the French power. These troops, under the command of Lord Willoughby of Break, broker the Bretons for some time masters of the field; but the French, retiring into their garrisons, gave them no opportunity of striking any decisive blow; and when the time of their service had elapsed, they returned home, without having afforded any essential support. The King of England, artfully labouring to avoid the expences of war, and yet to thwart the designs of the French court, became the dupe of his own policy; and, by the marriage of the Duchess of Brittany to the King of France, the province was peaceably annexed to his dominions. The King of England, envious of the schemes defeated, and unwilling to lose his claims of re-imbursement from Brittany, abandoned at length his cautious policy, and resolved to adopt more vigorous measures, when no measures could be of any avail. Upon pretence of a French war, he levied a Reiscntation on his subjects, (a mode of taxation peculiarly odious, as it was made at the discretion of commissioners;) and, lumelling summoned a parliament, vaunted, in a magnificent strain, of his determination to make a conquest of France. The English nobility, seized with military ardour, entered with full cedulity into the orontising schemes of their sovereign. On the 6th of October 1492, Henry landed at Calais with a well equipped army of 25,000 foot, and 1600 horse, and without a moment's delay laid siege to Boulogne. But with all this show of hostility, negociations had actually commenced before the army left England; and, after artfully giving it the appearance of being desired by his nobles, and owing to the delay of his allies, he concluded a peace with France on the third day of November. The principal article of the treaty, was the payment of nearly 745,000 crowns to Henry by the French government, partly as re-imbursement of the sums which he had advanced to Brittany, and partly as arrears of the pension due to Edward IV.; besides the stipulation of 25,000 crowns, as an yearly pension to himself and his heirs.

Before the conclusion of the war, a new pretender to the crown of England had begun to make his appearance. The old Duchess of Burgundy, not discouraged by the
failure of Simnel's imposture, propagated a report that his nephew, Richard Plantagenet, Duke of York, had escaped from the Tower when his brother was murdered; and procured a youth of proper parts to personate the prince. Perkin Oswest or Warbeck, the son of a Flemish Jew, after having been carefully instructed in the character which he was intended to assume, landed in Ireland about the commencement of hostilities with France, and, under the name of Richard Plantagenet, collected a number of partizans in that country. But, being joined by few persons of rank, he accepted an invitation from the King of France, where he was entertained with all the honours due to his supposed quality, and where he succeeded in attaching a number of English gentlemen to his interest. Dismissed from Paris when peace was concluded with Henry, he proceeded to the court of the Duchess of Burgundy, who pretended for some time to treat him as an impostor, but at last avowed her full conviction of his being the son of her brother Edward, and the legitimate heir of the English crown. Perkin, by his prudent conversation and princely deportment, ably supported the fiction of his royal descent; and the English became daily more and more prepossessed in his favour. Many of the nobles, disgusted with Henry's government, which tended to weaken their influence, and some even of his former favourites, who had been most instrumental in raising him to the throne, moved by credulity or ambition, and probably conceiving that their services had not been sufficiently rewarded, meditated a revolt in favour of his enemy. A regular conspiracy was formed against his authority; a correspondence settled between the malcontents in England and the pretender's friends in Flanders; and the whole nation, interested in the event, was held in a state of wonder and suspense as to the issue of the contest. Henry, well informed of all particulars, and conducting himself with his wonted caution and resolution, was actively employed in counteracting the projects of the conspirators. He first took measures to undeceive the people, by ascertaining that the Duke of York was really dead, and by inflicting punishments on those who were convicted of having been his murderers. He next exerted all his talents of policy and penetration, to detect the proofs of Warbeck's imposture; and, by a skilful employment of spies and bribes, he succeeded in developing his whole history, designs, and adherents. He immediately published to the nation the pedigree and adventures of the pretended Duke of York; and when his projects were properly matured, proceeded to inflict punishment upon the principal conspirators. Several men of note were publicly executed, others detained in custody, many pardoned; and, it has been remarked as a commendable feature of Henry's lenity and discrimination in prosecuting conspirators, that, if any one appeared to have been actuated by conscientious adherence to principle, or by affection towards the house of York, he generally experienced the king's clemency; but if he had indicated a restless love of change, or a turbulent opposition to the laws by which he was governed, he was then treated with greater severity.

Perkin, having made an unsuccessful attempt to land on the coast of Kent, proceeded to Ireland; and being there also frustrated in his hopes of support, he bent his course to Scotland. To James IV., who then governed that kingdom, he had been previously recommended by the French monarch, who was dissatisfied with Henry on account of his having joined the confederacy against his attempts upon Italy. This recommendation procured him a favourable reception from the King of Scotland; and his own insinuating address so far imposed upon that youthful and unsuspecting prince, that, in the full belief of his royal birth, he gave him in marriage the daughter of the Earl of Huntley, who was nearly related to himself, and who was one of the most accomplished ladies of her time. He next entered England at the head of a powerful army in support of his pretensions to the throne, but his story had now become stale, even in the view of the populace; and the presence of the Scots aroused the English rather to repel, than to join the invaders. A second inroad in his favour was attended with no better success; and, upon the conclusion of a treaty of peace between the two nations, he was obliged to leave Scotland, and to seek a new protector. His interests in Flanders had been completely overthrown, and his access to that country in a great measure barred, by a treaty of commerce with England. Consulting with his followers, Herne, Skelton, and Astley, three bankrupt tradesmen, he determined, under the name of Richard IV., to try the affections of the inhabitants of Cornwall, who had recently risen against the levying of a tax, and whose mutinous disposition, notwithstanding the lenity of Henry, still subsisted in a degree which seemed to promise him a ready adherence. On his first appearance at Bodmin, he was joined by 3000 of the populace, and immediately laid siege to the city of Exeter. Henry, upon receiving information of his proceedings, prepared with alacrity to meet him in the field; and was seconded with the utmost unanimity by the principal nobility and gentry of the kingdom. Perkin, upon hearing of his approach, though his followers now amounted to 7000, lost all hopes of success, and secretly withdrew to the sanctuary at Beaunieu. His wife, Lady Catharine Gordon, falling into the hands of the conqueror, was treated with the greatest generosity, and placed, with a suitable pension, in a reputable station near the person of the queen. Perkin being persuaded, upon the promise of pardon, to surrender himself into the hands of the king, was conducted through the streets of London, and committed to custody in the Tower. But, impatient of confinement, he soon made his escape, and, finding it impracticable to leave the kingdom, fled to the monastery of Thyne. The prior gave him up to the king, after having again secured his pardon, and he was himself prevailed upon to publish a confession of his imposture. Commit ted once more to the Tower, he soon renewed his attempts to regain his liberty, and contrived to engage in his plot the young Earl of Warwick, who was confined in the same prison. Their designs being detected, they were both condemned and put to death. The impostor had rendered himself unworthy of mercy; but the execution of the last male of the line of Plantagenet, who had been a prisoner from his childhood, and who had merely attempted to escape from oppression, occasioned the greatest discontent among the people, and must be regarded as the darkestblemish in the reign of Henry.

The authority of Henry being now securely established, and his reputation for vigour and sagacity spread over all Europe, his amity and alliance was courted with every demonstration of respect by the most powerful foreign princes. The Princess Margaret, his eldest daughter, was contracted to James the Fourth of Scot-
HENGLAND.

land; but as the royal bride was only in the eleventh year of her age, the marriage was not consummated till three years afterwards. A similar connection, which had long been negotiating between Arthur, Prince of Wales, and the Princess Catherine, third daughter of Ferdinand and Isabella of Spain, was concluded about the same time, and the marriage celebrated with great pomp about the end of the year 1501. These two matches were afterwards productive of the most important events; the former laying the foundation for the future union of the English and Scottish crowns; and the latter proving a remote occasion of the reformation of religion in Christendom. Prince Arthur sickened and died a few months after his marriage; but his father, still desirous to continue his alliance with the royal family of Spain, after procuring the pope’s dispensation, obliged his second son Henry, whom he created Prince of Wales, to be contracted to the infant. During these more prosperous incidents, the queen died in childbirth, and the child survived her only a few days; but, as she had never gained the affections of her husband, though deservedly the favourite of the nation, it was not supposed that her death made much impression upon the king; and he soon after began to lay plans for a second marriage. He first turned his thoughts to the Queen Dowager of Naples; but, hearing that her dower was diminished, he abandoned all further pursuit. In 1506, Philip, Archduke of Austria, who had married Joan, heiress of Castle, having embarked with his consort for Spain, was driven by a storm into the port of Weymouth, and was received by Henry with every possible demonstration of respect. Ever watchful how to draw advantage from every incident, he first prevailed upon Philip to conclude a more favourable commercial treaty, than that which hitherto existed between the English and the Low Countries, and next negotiated a lucrative matrimonial alliance between himself and Philip’s sister, Margaret, Duchess Dowager of Savoy. But the accomplishment of this intended connection was prevented by Henry’s declining health, and by the commencement of a disease which soon terminated in his dissolution. In the view of approaching death, the king applied himself with much earnestness to acts of justice, piety, and mercy; and had recourse to many of those superstitious practices, which were then held most efficacious for conciliating the favour of heaven. He paid the debts of all persons in London who were imprisoned for small sums; and, with the exception of a few of the more aggravated cases, issued a general pardon to all criminals. He directed 2000 masses to be said for his soul within a month after his decease; distributed alms to paupers and prisoners, upon condition that they prayed fervently for his future felicity; and constituted commissioners, to make restitution to all whom he had injured or oppressed. He expired in his favourite palace at Richmond, in the 54th year of his age, and the 24th of his reign.

Henry VII. was, in stature, above the middle size, and though of a slender form, yet strong and active. His deportment was grave and stately; but when any great point was to be gained, he was capable of displaying the most insinuating address. Though not defective in personal courage, and always collected in seasons of danger, he was rather cautious than enterprising in the field. He was indefatigable in public business, and descended to the most minute details; kept his views impenetrably secret, and only prescribed to his ministers the parts which they were to act. His understanding, though not remarkable for acuteness, was sure in its deliberations, and the general success of his measures procured him a very high reputation for political wisdom. He was more deficient in the feelings of the heart than in the faculties of the mind; and was little susceptible of the social and generous affections. An inordinate love of money, and an unrelenting hatred to the house of York, were his ruling passions, and the chief sources of his vices and his vexations. During the latter part of his life, in particular, his strict economy degenerated into absolute avarice, which broke through all restraints; and with the assistance of two rapacious ministers, Empson and Dudley, he committed the most arbitrary exactions upon his subjects. By his frugality and extortions, he accumulated immense wealth, and is said to have possessed, at his death, in ready money, the sum of £1,800,000. But the royal coffers being then the only treasury of the state, he may be said to have saved for the public; and though a few individuals may have suffered from his rapacity, he left the nation wealthy and flourishing. His reign, in a general view, was prosperous at home and honourable abroad; and though not personally the least, he was politically the most useful prince, next to King Alfred, that had hitherto filled the throne of England. He loved peace, without fearing war; and extended his power by wise treaties, rather than expensive victories. It was the uniform tendency of his measures to depress the nobility and clergy, and to raise up and humanise the people. By a law, empowering the nobles to break their entail and alienate their possessions, the overgrown authority and estates of the barons were gradually diminished, while the property and influence of the commons were proportionally increased. By repeated statutes, and a rigorous enforcement of the laws, he prevented the great families from giving livgeries or badges to their dependants and retainers; and thus effectually suppressed those armed bands, maintained around the castle of every baron, and ready for every act of violence or insurrection. He was not so successful in his attempts to abolish the privileges exercised by monasteries, in affording refuge to the most notorious offenders; and all that he was able to accomplish by his influence with the pope, was to procure a regulation, that if any, who were once registered as sanctuary-men, should again sally forth to commit fresh offences, they might be dragged from the place of their refuge, and delivered up to justice. His great efforts were uniformly directed to promote a spirit of industry, and to extend the benefits of commerce among his subjects. In these views he repealed various statutes, which acted as restraints upon manufacturing and mechanical trades; endeavoured to draw the towns from the neighbourhood of strongholds to more commercial situations; and never failed, in his treaties with foreign powers, to secure the commercial interests of the kingdom. He expended fourteen thousand pounds in building one ship, which was called “the Great Harry,” and which may be considered as, in fact, the beginning of the English navy; since the government, before this period, had no other mode of raising a fleet than by hiring or pressing the vessels of merchants. By his prudence and perseverance, in short, he effected a great and beneficial change upon the state of the kingdom; enacted many wise and salutary laws; restored, or rather established commerce; reduced to just subordination a factious and insolent aris-
tocracy; and taught the peaceful arts of civilized life to
a warlike and turbulent people.

Henry VIII, ascended the throne, when he was about
18 years of age, with every advantage that a young
prince could possess, and with the fairest prospects of a
happy reign. Unitiiig in his person the claims of the
houses of Lancaster and of York, his title was indisputed,
and all factions were extingiuished. Beautiful in his form,
expert in every manly exercise, accomplished in all the
literature of the times, and even an adept in school divinity,
he was regarded by his people with indulgent affection
and high expectation. At peace with all Europe,
and in possession of a well-stored public treasury, he
found his subjects advancing in commerce and the arts,
and was himself furnished with the means of contributing
to their power and prosperity. His first measures were
dictated by the wisest policy, and were at the same time
well suited to increase his popularity. He chose as his
ministers, men of eminent abilities and experience; con-
formed, by proclamation, the general pardon granted by
the late king; and renewed the treaties of peace which his
father had concluded with Scotland, France, and Spain.
But, destitute of wisdom to improve his advantages,
and of virtue to prosecute the welfare of his subjects, he be-
came negligent of public affairs; and abandoning himself
to idle dissipation, entrusted the government of the state
to the hands of his ministers. Even in gratifying the
wishes of the nation, he shewed himself more oppressive
than just. Empson and Dudley, the instruments of the
late king's rapacity, were brought to trial; but, as they
could not be impeached for having merely put the laws
in execution in obedience to the will of their sovereign,
and as they had cautiously preserved the royal orders for
all their proceedings, they were charged with a treason-
able design to seize the administration of the govern-
ment upon the decease of their late master, and, by the
weight of popular prejudice and of court influence, with-
out either probability or proof, were condemned and ex-
cuted.

One of the first and most important matters, which
engaged the attention of the council, was the marriage of
the king to his brother's widow, Catherine, the Infanta
of Spain, to whom he had formerly been contracted, and
a dispensation for the union obtained from the Pope.
Though Henry himself was averse to the match, and it
was opposed by Warham, archbishop of Canterbury, as
an incestuous alliance, yet the majority of the council,
for political reasons, recommended the completion of the
contract. The royal nuptials were solemnized at Green-
wich, June 7, 1509, and the ceremony of the coronation
was soon afterwards performed with the most extradi-

tory pomp and magnificence. Engaged in a succession
of expensive amusements, the young king seemed to
think himself born for no other object, than to dissipate
the treasures which his father had amassed; but not con-
tented with his own private extravagance, he proceeded
to involve his people in the heavier burdens of an
meaning and unnecessary war. Suceded by the artifices
of Pope Julius II. and of Ferdinand king of Spain, he
entered into a league with them against Louis XII.
of France. He was flattered with the idea of being the pro-
tector of the church, and of receiving the title of "The
Most Christian King," which the pope had promised
to transfer from the French to the English monarch. He
was so far blinded by vanity and ambition, as even to
announce an intention of conquering France, and annex-
ing it to the English crown. The parliament and the
nation entered with sufficient alacrity into his views, and
granted the most liberal supplies for prosecuting the war.
In 1513, having appointed the queen regent of the king-
don, Henry landed at Calais with a powerful army; and
after an easy victory over the French, a few useless sieges,
and an expensive display of his magnificence at Tournay,
he returned to England, with sufficient honour to his
troops, but with no advantage to his kingdom. His un-
provoked attack upon the French king, had involved him
in a war also with James IV. of Scotland; and, though
his arms were here attended with greater military success,
by the fall of the Scottish king, with the flower of his
nobility, in the memorable battle of Flodden-field; yet
little political benefit accrued to his subjects to compen-
sate the death of his sister's husband, who might have
proved one of his most faithful allies. Discovering,
however, the selfish views of his confederates, who were
severally negotiating secret treaties with the French
king, he readily listened to the overtures of Louis, with
whom he not only concluded a peace, but also formed a
family alliance, by giving him in marriage his youngest
sister, the Princess Mary.

Henry, now left at liberty to indulge his love of ex-

pensive pleasures, soon exhausted all the treasures which
he had inherited from his father, or obtained from his
parliament; and he had found a minister ready to gratify
his most extravagant demands, and to execute his most

in England. 649

Cardinal

Wolsey

minister.

The king's marriage.

The war against France, 511.

Peace with France, August 7, 1514.

Interviews with Charles and Francis, 1520.
but meditated to retrovert the king and the minister in his interests. An offensive alliance was soon after concluded with the pope and emperor against France; and the Princess Mary, Henry's only child, was betrothed to Charles.

The king, strictly attached to the church of Rome, and particularly displeased with the attacks of Luther upon his favourite author, Thomas Aquinas, opposed, with all his influence, the progress of the Reformation; and even wrote a book in Latin against the great reformer, a production which is considered as sufficiently creditable to his talents, and which procured him from Pope Leo, the title of "Defender of the Faith."

An invading army was sent into France in 1522; and in the year following, an expedition was made against Scotland, in order to break the alliance which subsisted between the Scottish and the French governments. But the immense treasures of Henry VII. were now exhausted, by a succession of empty pageants, guilty pleasures, and useless enterprises; and it was necessary to find money, not only for the prosecution of the war, but even for the ordinary charges of the government. Large sums were levied under the name of "a benevolence," which were not granted without loud murmurings on the part of the nation. A parliament and a convocation were summoned; but neither the clergy nor the commons were so easily managed, or so liberal in their grants, as Wolsey had expected, and seven years were suffered to elapse before they were again assembled. Wolsey, attempting to render the king independent of the parliament, first levied in one year what they had granted payable in four; and next proceeded to raise money upon the king's authority alone. The people, at length roused from their long submission by the exorbitancy and the illegality of his exactions, openly opposed the commissioners, and began to threaten a general insurrection. Henry, alarmed by the consequences of his minister's precipitate measures, issued circular letters to all the counties, disavowing the assessment, and declaring that he meant only to apply to his subjects for "a benevolence." But the city of London, hesitating to comply with his demand, and open insurrections breaking out in different parts of the kingdom, the king found it prudent to suspend his meditated usurpations; and the cardinal hastened to make his peace with the sovereign, by presenting him with a magnificent palace at Westminster, which he pretended to have erected, from the first, for his master's use. But a period was now approaching to the exorbitant power of this artful and ambitious prelate; and the same event, which shook his hold of the king's favour, served to overthrow in England the whole system of papal tyranny.

Henry had begun, (at what time and from what motives is not precisely ascertained,) to entertain doubts concerning the legality of his marriage with his brother's widow, Catherine of Spain; and to meditate the design of procuring a divorce. It is certain, that Henry VII. afterwards convinced of the unlawfulness of the match which he had contracted for his son, charged him, upon his death-bed, never to consent to its celebration; and that the states of Castile, when treating respecting the proposal of a marriage between the Emperor Charles and Henry's daughter Mary, had, among other objections, insisted upon the illegitimate birth of that princess. The marriage of Henry and Catherine had been considered by all parties from the beginning as sanctified only by the dispensation of the pope; but, by the progress of the Reformation in England, the authority of such decisions was more freely questioned than in former times. Cardinal Wolsey, and all the English prelates, with only one exception, concurred in declaring that the king's marriage was unlawful; and Henry found it decided by his favourite theologian Aquinas, that, though the pope may dispense with the rules of the church, the laws of God cannot be set aside by any authority, inferior to that by which they were enacted. The decay of Katherine's beauty, and the passion which Henry had conceived for Anne Boleyn, one of the queen's maids of honour, though not perhaps the exciting causes of his scruples, furnished additional motives to his desire of a divorce.

Formal and repeated applications were made to the pope, to annul the king's marriage with Catherine; but his holiness, while he professed his desire to comply with Henry's request, was averse by the power of the emperor; and practised various artifices, to evade the demands of the English monarch. Urged at length by his solicitations, he commissions Cardinal Campegio as his legate to London, who, together with Cardinal Wolsey, should hold a court for trying the validity of the king's marriage; but, when the proceedings were nearly brought to a conclusion, the legate, upon some frivolous pretences, proscribed the court, and the pontiff a few days after adjourned the cause to his own judgment at Rome.

Wolsey had long foreseen, that his ruin would be the consequence of the king's suit for a divorce; and his fall took place more suddenly than could have been anticipated. Solicitous to gratify his royal master, yet fearing to offend the pope, his conduct, throughout the whole course of the affair, was mysterious and temporizing. The king, at last, confident of his minister's talents, or blinded by the ardour of his wishes, suspected his fidelity and zeal in managing the affair. Anne Boleyn, who had been possessed against the cardinal, imputed to him the failure of her hopes; and her influence over Henry contributed to fortify his suspicions against his favourite. Even the queen and her partizans, judging of Wolsey by the part which he had openly acted, expressed the greatest animosity against him; and the most opposite factions seemed to combine for the overthrow of that haughty minister.

Henry, after remaining some time in suspense, at length resolved upon the ruin of Wolsey; required him to deliver up the great seal, and to retire from his palace in London to his country seat near Hampton Court. He next ordered him to be indicted in the star chamber, and abandoned him to all the rigour of the parliament; but though many charges were brought against him, it was found difficult to establish the proof of any crime; and Henry remitted the sentence of forfeiture, which had been pronounced against him, and restored his property which had been seized. Afterwards, however, finding that he stood in the way of his measures against the pope, renewed the prosecution against him; commanded him to be arrested for high treason, and to be brought to London for trial. But by the fatigues of the journey, the agitation of his mind, or, as some have alleged, by the effects of poison which he had taken, he was seized with a violent disorder by the way, and died at Leicester Abbey. See WOLSEY.

Henry, being thus freed from a person whom he regarded as an obstacle to his intentions, resolved, by the
advice of Cranmer, to have the legality of his marriage discussed by all the universities of Europe; and having at length procured their suffrages, as well as the opinions of the Rabbis in his favour, he determined to commence an open resistance to the pope's authority. By the revival of an old statute, which had been employed to ruin Wolsey, and which rendered his exercise of the power of legate unlawful, though it had been done with his own permission, he indicted all those ecclesiastics who had submitted to the legatine court, for having violated the law; reduced them to compound for their offence by a fine of L.118,000; and, at the same time, extorted from them a confession, that "the king was the protector and the supreme head of the church of England." By the strict execution of the old statute above mentioned, much of the profits, and still more of the power, of the church of Rome was cut off; and by several new acts, the usurpations of the pontiff were farther abolished.

Henry, now determined in his own mind, and prepared for all consequences, privately married Anne Boleyn; and upon her becoming pregnant, publicly announced her as his wife, by carrying her in a magnificent procession through the streets of London. His marriage with Catherine having been pronounced invalid by a court held under Archbishop Cranmer, the new queen was publicly crowned with suitable splendour, and was soon afterwards delivered of a daughter, who received the name of Elizabeth. When intelligence of these transactions was conveyed to Rome, the pope immediately issued a sentence, declaring the nullity of Cranmer's decision, and requiring Henry, upon pain of excommunication, to restore Catherine to her place as his only lawful wife. The king, upon receiving information of this decree against him, no longer delayed to execute his long meditated scheme of renouncing the Papal jurisdiction.

A parliament was assembled, which ratified the king's marriage with Anne Boleyn, and appointed the crown to descend to the issue of this connection; declared the king to be the only supreme head on earth of the church of England, and granted him a right to all annates and tythes of benefices, which had hitherto been paid to the see of Rome. The clergy, assembled in convocation, passed a vote, that, by the law of God, the Roman pontiff had no more jurisdiction in England than any other foreign bishop; and the bishops even took out new commissions from the crown, acknowledging all their spiritual and episcopal authority to be derived ultimately from the civil magistrate.

While, however, the king of England threw off the political yoke of the church of Rome, he adhered, with blind obstinacy, to its most pernicious errors; and his subjects were thus brought into a dilemma, which exposed all parties to persecution at his pleasure. It was a capital crime to acknowledge the pope's supremacy; and, on the other hand, it was equally punishable to profess the reformed principles. The Queen, Cromwell, secretary of state, and Archbishop Cranmer, secretly favoured the Protestant tenets; but the Duke of Norfolk, Gardiner bishop of Winchester, and Sir Thomas More, who succeeded Wolsey as chancellor, were zealous supporters of the old religion. The latter, with all his natural gentleness and enlarged mind, acted the part of a furious inquisitor in the prosecution of heresy; and, under his administration, many were put to death for harbouring the reformers, neglecting the fasts of the church, or declining against the vices of the Popish ecclesiastics.

By these severe executions, however, the people were rendered only the more favourable to the new doctrines, and inspired with greater horror of the old; while on the other hand, many eminent individuals, who were friendly to the Romish church, and even instrumental in those cruelties, suffered in their turn whenever they ventured to oppose the king's measures. Fisher, bishop of Rochester, and Sir Thomas More, having refused to take the oath which acknowledged Henry's supremacy as head of the church, and expressed an approbation of his divorce, were thrown into prison, and treated with unusual severity. Archbishop Cranmer, after having failed in his endeavours to persuade them to comply, used all his influence to alleviate their sufferings, and to save them from the fate with which they were threatened. But the king, knowing their attachment to the see of Rome, and the high regard which was paid by all its adherents to their opinion and example, was determined to awe the Papal party by their destruction. They were tried, condemned, and beheaded. (See More.) When their execution was reported at Rome, the utmost indignation was expressed against Henry; and he was denounced by the Italian orators, as worse than Caligula, Nero, Domitian, and all the most unrelenting enemies of the church. Paul III. who had succeeded to the pontificate, summoned the king of England, with all his adherents, to appear at Rome, within ninety days, to answer for his crimes; and should they fail to obey, pronounced the sentence of excommunication, depriving Henry of his crown, laying the kingdom under an interdict, declaring the issue of his second marriage illegitimate, dissolving all his leagues with any Catholic prince, bestowing his dominions upon any invader, absolving his subjects from their oath of allegiance, and declaring it lawful for any one to seize, enslave, and plunder them, as long as they retained their fidelity to his person. But these censures, though passed, were not published, till all agreement with the English monarch should become hopeless, and till the emperor should be in a condition to carry the sentence into execution. Henry, on his part, knowing that he might expect every injury which it might be in the power of Charles to inflict, exerted all his policy to incapacitate his adversary from giving effect to his resentment, renewed his league with Francis, and even made advances to the leaders of the Protestant league in Germany. In the mean time, the decease of Queen Catherine, by removing the foundation of the emperor's principal quarrel with Henry, induced the former to make attempts rather to conciliate his friendship, and to detach him from the interests of France. Thus was the king left at full liberty to exercise the decisive authority which he had acquired over his subjects, and to pursue his schemes for the utter destruction of papal authority in his dominions.

The monks, in their rage against Henry, employed all their influence to inflame the people against his government; and having engaged in various treasonable practices, the king resolved to root them out of his kingdom. Commissioners were appointed to inspect the monasteries; and the greatest disorders having been detected, the parliament was directed to suppress all the smaller religious houses, and to confiscate their goods and revenues for the use of the crown. The reformers gained a further triumph, by a vote passed in convocation, and understood to be directed by the king, for publishing a new translation of the sacred scriptures; but their cause sustained,
about the same time, a severe blow in the fate which held their great patroness Anne Boleyn. Her attachment to the Protestant opinions created her many inveterate enemies, who only waited for a favourable occasion to destroy her influence with the king. Henry’s love to this lady, during the six years which were employed in procuring his divorce from Catherine, seemed to increase by every obstacle which was thrown in the way of his desires; but he had not long obtained possession of his object, when his affection languished, and his heart became estranged from his consort. As she had been delivered of a dead son, which disappointed his extreme desire of male issue, his violent temper was ready to regard her as answerable for the misfortune; and her enemies took occasion, from her levity of behaviour, to inflame the king’s jealousy, by putting the worst construction upon the harmless, but unbecoming liberties to which she was addicted. Her sister-in-law particularly, the Viscountess of Rocheford, a woman of most profligate character, regardless of either truth or humanity, instigated the most cruel suspicions into the mind of Henry; and even went the length of suggesting, that the queen was engaged in a criminal correspondence with her own brother. The king’s jealousy became more unremitting and more ready to lay hold of the slightest circumstance, in consequence of his love being already transferred to another object, Jane Seymour, one of the queen’s maids of honour. The queen’s innocence cannot reasonably be questioned; and even though she had been more guilty, Henry’s own notorious infidelities as a husband might have restrained him from exacting the punishment of death. But his cruelty was as insatiable as his lewdness; and the unhappy object of his rage, being tried for adultery and incest, was condemned, without any legal evidence, to be burned or beheaded at the king’s pleasure. When this dreadful sentence was pronounced, she discovered no emotions of terror; but lifting up her hands towards heaven, she said, “O Father! O Creator! thou who art the way, the truth, and the life, thou knowest that I have not deserved this fate.” She continued to the last to make the most solemn protestations of her innocence; and behaved, at her execution, with the utmost decency and resolution. Henry himself gave the best proof of the queen’s innocence, and of the sentiment by which he had been actuated in her condemnation, by celebrating, on the very day after her execution, his marriage with Jane Seymour; but his new consort died in the following year, after having been delivered of a son, who was named Edward.

Having summoned a parliament and convocation, he found both assemblies completely subservient to all his views; and having acquired, by their enactments, the most absolute authority, he proceeded, without restraint or remorse, to gratify the savage and selfish passions of his heart. The tyrannical nature of his measures, and particularly the destitute condition in which the monks, expelled from the suppressed monasteries, were left to wander about the country, at length excited strong discontent among the people, which in many places broke out into formidable insurrections. These, however, having been repressed, and their principal leaders put to death, his authority at home, and his influence with foreign powers, having been confirmed by the birth of a son, he resolved to seize the present opportunity for accomplishing the entire destruction of the monasteries. To this measure he was impelled, at once by resentment against some of the abbots, who were suspected of having encouraged the recent disturbances, and by his rapacious desires to supply the means of his profusion. In consequence of the king’s unlimited power, and the progress of the Reformation even among those who had taken the vows, his design was so successfully conducted, that, in less than two years, he got possession of all the monastic revenues. He had now suppressed, at different times, 645 monasteries, (of which 28 had abbots possessed of seats in parliament,) 90 colleges, 257 chantries and free chapels, and 110 hospitals. The whole annual revenue of these establishments amounted to £161,100; a sum which, contrary to what has been generally apprehended, did not exceed the twentieth part of the national income. In order to reconcile the people to these severe measures and extensive innovations, the most detestable stories were propagated respecting the immoral lives of the monks; their relics, and other superstitions, were exposed to ridicule; and their pretended miracles openly disclosed: (See Reformation.) The nation was also made to understand, that the king would henceforth have no occasion to levy taxes, but would be able, from the abbey lands alone, to defray, both during peace and war, the whole charges of government; while, at the same time, he interested the higher orders in his measures, by giving in presents, or selling at low prices, the revenues of convents, and even the benefits of the regular clergy, to his favourites and courtiers.

By all these acts of violence, the pope was at length incited to publish the bull which had been passed against the king of England; and having hopes, from the reconciliation which had now taken place between Charles and Francis, that they would unite in the execution of the sentence, he publicly delivered Henry’s soul to the devil, and his dominions to the first invader. Labels were dispersed anew, denouncing him as worse than all preceding persecutors, and particularly reproaching him with his resemblance to the Emperor Julian, whom he was said to have imitated in his learning and apocraypocy, while he was much inferior to him in point of morals. In some of these publications, Henry discovered the pen of his kinsman Cardinal Pole, whom he had originally distinguished with his favour, but who had taken a violent part against the king in support of the papal claims. Several of the nobility were brought to trial, and condemned to death for having joined in a conspiracy with the cardinal, in the design, as was suspected, of raising him to the throne by a marriage with the Princess Mary.

Though Henry had greatly changed the theological sentiments in which he had been educated, he was extremely bigotted and dogmatical in the support of those which he retained; and so much had his native arrogance been inflamed by the flattery of his courtiers, that he thought himself entitled to regulate, by his own private standard, the religious faith of the whole nation. He particularly rested his orthodoxy upon the most absurd of all the popish tenets, namely, the doctrine of transubstantiation; and determined to maintain, in this essential article, the purity of the Catholic faith, he denounced all departure from the belief of this point as heretical and detestable. In his vanity and zeal, he even held a public disputation on the subject with one Lambert, a schoolmaster, who had appealed to the king’s judgment; and who was cruelly burned at the stake, for his opposition to this favourite test. In the parliament a bill was passed, called by the Protestants the “bloody
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Statistics, which reduced the essential articles of religion to the number of six, namely, the real presence, communion in one kind, the perpetual obligation of vows of chastity, the edibility of the clergy, the utility of private masses, and the necessity of auricular confession. A denial of any of these points was punishable with death; and, even though recanted, subjected the offender to the forfeiture of his goods, and imprisonment during the king's pleasure: but, in the case of the first, the privilege of recantation was not admitted; which was a degree of severity hitherto unexampled, and even unknown to the inquisition itself. With the most abject servility, the parliament enacted whatever the king and his ministers thought proper to dictate; confirmed the surrender of the monasteries, and secured the property of the abbey lands to the king and his successors for ever; attained of high treason, without any legal evidence or inquiry, but upon a mere suspicion of having aided the insurgents, the Marchioness of Exeter, the Countess of Salisbury, Sir Adrian Fortescue, and Sir Thomas Dingley,—the two last of whom were executed; and at last, in one sweeping act, made an entire surrender of all their civil liberties, by giving to the king's proclamations the same force as a parliamentary statute.

As soon as the act of the six articles had passed, not less than 500 persons, in consequence of the zeal with which the Catholics informed against offenders, were committed to prison; but though Cranmer, Cromwell, and others favourable to the Protestant cause, had not been able to prevent the passing of the act, they found means to evade its execution; and, in consequence of their remonstrating against the cruelty of punishing so many delinquents, they were all set at liberty. The king, at the same time, as if desirous to give each party an opportunity of triumphing in turn, permitted every individual to have in his family a copy of the new translation of the Bible.

In the course of the year which followed the death of Queen Jane, Henry had been engaged in several matrimonial treaties, particularly with the duchess dowager of Milan, and with Mary of Guise, who married James V. of Scotland; but at length, by the advice of Cromwell, he contracted a match with a Protestant princess, Anne of Cleves, of whom a flattering portrait had been shown to him, and whose relations had great weight among the Lutheran leaders. Finding, however, that her beauty did not correspond with the descriptions which he had received, he conceived a strong dislike to her person; and was induced, from mere political motives, to complete the marriage.

A parliament was this year assembled, in which none of the abbots or priors were allowed a place; and the king, after informing them by the mouth of the chancellor, that, in consequence of the great diversity of religions which still prevailed, he had appointed some eminent divines to draw up a list of tenets to which his subjects were to assent, proceeded to make the very unexpected demand of a subsidy, on account of the great expense which he had incurred in putting the kingdom in a proper state of defence. Already had he dissipated the immense sums which he had acquired by the plunder of the church, and he had this very year suppressed the only remaining religious order in England, the Knights of St John of Jerusalem, or "the Knights of Malta," as they are commonly called, whose large revenues formed no contemptible addition to the spoil which he had collected from the monasteries. The commons, though lavish of the liberty and blood of their fellow subjects, were sufficiently frugal of their money; and, had it not been owing to the earnest desire of both the Protestant and the Popish parties to gain the king to their views, he would have found it no easy matter to procure their consent to a demand, which was so contrary to all the expectations which had recently been held out to the public, of a long exemption from supplies to the crown.

These measures, though passed in parliament, excited universal murmurs against the king and his minister, Cromwell. The latter had long been hated by the nobility, on account of his low extraction, and his possession of many offices and honours which they considered as belonging only to persons of illustrious birth; and he was equally obnoxious to the clergy and the people, as the supposed author of Henry's rapacious proceedings. By the Catholics he was regarded as the concealed enemy of their religion; and by the Protestants, he was reproached with the timidity or treachery of his conduct, in giving his countenance to the persecutions by which they were harassed. He had lost all favour with the king, in consequence of his having been the adviser of his late joyless marriage with Anne of Cleves; and, as Henry had now fixed his affections upon Catherine Howard, niece of the Duke of Norfolk, who had long been at enmity with Cromwell, he was easily persuaded, at once to seek a divorce from his queen, and to consent to the ruin of his minister. Cromwell was accused of heresy and treason, and, without examination or evidence, was condemned to death. He made the most humble submission to the king, and wrote to him for mercy in so moving a strain as is said to have drawn tears from his eyes. Archbishop Cranmer interceded earnestly in his behalf, and even went so far as to affirm, that "no king in this realm ever had such a servant." But the charms of Catherine Howard and the importunities of her friends prevailed. Cromwell, one of the wisest and most upright ministers who had ever served in England, and who, in all his exaltation, betrayed no insolence towards his inferiors, and no forgetfulness of his former obligations, fell a sacrifice to the passions of a capricious tyrant, to whom he had been only too obsequious.

The measures for Henry's divorce were carried on at the same time with the bill of attainder against Cromwell. The convocation and parliament readily annulled his marriage, upon his own affirmation, that he had not consented inwardly to the match, and had never consummated the union. Anne herself discovered the utmost indifference in the matter; and, accepting a settlement of L. 3000 a-year, freely consented to the divorce; but, unwilling to return to her own country after sustaining such an affront, she lived and died in England.

The king's marriage with Catherine Howard, which soon followed his divorce from Anne of Cleves, was regarded by the Catholics as a favourable event to their party; and a furious prosecution was commenced against the Protestants who offended against the law of the six articles. Nor did Henry spare the Papists who denied his supremacy; but displayed, with disgusting ostentation, his intemperate oppression of both parties. Three Protestants, Barnes, Jerome, and Gerard, coupled with three Catholics, Abel, Fisherstone, and Powell, were carried to execution at the same time; which gave occasion to a foreigner to remark, that, "in England, those who were against the pope were burned, and those who.
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In order to quiet the northern districts, and to confer with the king of Scotland, Henry took a journey to the city of York; but James being bribed by his clergy, who dreaded the consequences of this meeting, failed to appear; and his uncle, enraged at this affront, immediately ordered war to be carried on against the Scots by sea and land. Returning to his capital, he experienced a disgrace which touched him much more sensibly. He had openly proclaimed the satisfaction which he enjoyed in his new marriage, and even returned solemn thanks to heaven for his conjugal felicity. On the very next day he received information, too circumstantial and authentic to admit of doubt, that his concert had led a very disgraceful life before marriage, and was strongly suspected of still continuing her licentious indulgences. Two of her paramours having confessed their guilt; the queen herself, while she insisted upon her fidelity to the king's bed, having admitted her former acts of lewdness; and the king being little inclined to make any distinction between these degrees of criminality, she was condemned to death, and beheaded on Tower-hill, along with the infamous Duchess of Rochford, who had conducted her secret amours. At the same time, a bill of attainder for misprision of treason was passed against her grandmother, the old Duchess of Norfolk, her uncle Lord Howard and his lady, the Duchess of Bridgewater, and several other persons of distinction, because they had concealed the queen's vicious course of life; but, probably from reflecting upon the oppressive cruelty of such a proceeding, he afterwards granted a pardon to most of them. In order, however, to guard against the renewal of such misfortunes, he enacted several rigorous and indelicate laws against concealing the incontinence of future queens, which furnished matter of great derision to the people, and which were all repealed in the first year of the following reign.

Henry, in order to enrich his exchequer without endangering a subsidy, took further steps to dissolve colleges, hospitals, and similar institutions; and the parliament, to promote his purpose, annulled all the local statutes of these foundations, which prevented the surrender of their revenues. He proceeded to make inroads also upon the secular clergy, and pillaged several of the wealthier sees of their chapter lands, with which he enriched his parasitical flatterers. While he gratified his rapacity by plundering the church, he continued to indulge his bigotry by persecuting heretics. He engaged the parliament indeed, to mitigate the law of the six articles, as far as regarded those priests who entered into the married state; but he still persisted in maintaining the purity of speculative principles, and enforcing uniformity in religious sentiments. He had appointed a commission, to frame a system of faith for the nation; and the parliament, in the grossness of their servility, had passed a law in 1541, by which they blindly ratified, by anticipation, all the tenets which these divines should afterwards establish with the king's consent. A small volume was at length published, called the Institution of a Christian Man, which may, in fact, be considered as the composition of the king, and which was voted by the convocation to be the standard of sound religion. In all the great points of Christian truth, this production favoured the sentiments of the reformers; but the sacraments, which a few years before had been limited to three, were here again increased to the number of seven, conformably to the opinion of the Catholics. But the king soon after ordered a new book to be composed, called The Condition of a Christian Man, which, without consulting the convocation, but by his own authority and that of the parliament, he published to the nation as the model of their faith, and required them to veer about in their belief at every signal of his inconstancy. He was much perplexed, however, what course to take with the scriptures; and seems to have felt the difficulty of reconciling his requisitions of uniformity with the permission of free enquiry. With the concurrence, therefore, of the parliament, he retracted the concession which had been formerly made, that every person might have the scriptures in his family, and now prohibited all but gentlemen and merchants from perusing them. Even to these classes the permission was granted with evident hesitation and dread of the consequences; for they were allowed to read for themselves, with this cautious proviso, "so it be done quietly, and with good order."

The mass-book also passed under the king's revision; but the principal alterations consisted in striking from the calendar a few fictitious saints, and erasing the name of the pope wherever it occurred. This latter apellation was carefully excluded from every new book that was printed, and blotted out in every old one that was sold, in order, if possible, to abolish the term from the language, and to make the people forget that such a personage existed.

After the death of James V. of Scotland, Henry projected the scheme of uniting that kingdom to his own dominions, by marrying his son Edward to the heiress of the Scottish crown; and a treaty to that effect was actually concluded, by which it was agreed, that the Princess Mary should remain in Scotland till she should be ten years of age; that she should then be sent to England to be educated; and that the kingdom, notwithstanding its union with England, should retain its own laws and privileges. But all these prospects of perpetual amity between the two nations were destroyed by the intrigues of Cardinal Beaton, and the weakness of the Regent James Hamilton, Earl of Arran, and the violent temper of Henry himself, who, upon the first appearance of opposition to his views, precipitated a new war against the Scots. His fleet landed ten thousand men at Leith, who took and pillaged the city of Edinburgh, while another army laid waste the whole country between Berwick and Haddington. By this violent incursion, he only inflamed the passions of the Scots without subsiding their spirit; and, as was commonly observed, did too much if he wished to solicit an alliance, but too little if he intended to make a conquest.

In the mean time, while thus ardently bent upon providing a match for his son, he formed another matrimonial connection for himself; and took as his sixth wife Catherine Parr, widow of Nevil Lord Latimer, a lady who secretly favoured the sentiments of the reformers; but who was obliged to conduct herself with so great caution, that she durst not even intercede for three Protes-
tart gentlemen, and a young lady of her own acquaintance, who were all burnt at Windsor a short time after her marriage. Once indeed she attempted to argue with the king on theological subjects, who complained of her to Bishop Gardiner, and who was instigated, by the advice of that prelate, to proceed against her with the utmost rigour. Articles of impeachment were actually drawn up for her trial, and the hour fixed for her commitment to the Tower; but having received timely intimation of her approaching fate, she found means, by her prudence and address, to pacify her husband, and disappoint her enemies.

The war with Scotland had led to a rupture with France; and in order to support the burdens of this double contest, Henry, instead of demanding a subsidy from his parliament, (which with all his authority he generally found it difficult to control in pecuniary grants,) had recourse to many dishonourable modes of filling his treasury. He required new loans from his subjects, though he had recently enacted laws, which exempted him from the payment of his old debts. He increased the nominal value of gold and silver; and even caused base money to be coined, and to be made current by proclamation. Resolving, in concert with the emperor Charles, to command his army, which was destined for the invasion of France, he thought proper, before his departure, to fix the rule of succession to the crown. By the act passed for this purpose, it was settled, 1. On Edward Prince of Wales, and his lawful issue; 2. On the king's issue by his present or any future queen; 3. On the Princess Mary, and her lawful issue; 4. On the Princess Elizabeth, and her lawful issue; and, failing all these, on such as the king pleased to appoint by letters patent, or by his last will. But, with his usual caprice, while he opened the way to the throne to Mary and Elizabeth, he would not allow those acts to be reversed which had declared them illegitimate, and reserved the power of still excluding them from the succession, if they refused to submit to any conditions which he might be pleased to impose.

Henry having appointed the Queen to the office of Regent during his absence, passed over to Calais with an army of 30,000 men, accompanied by the principal nobles and gentlemen of his kingdom. But, after taking Boulogne, a misunderstanding arose between the allied sovereigns; and the king of England returned home, as in all his military enterprises, with an acquisition of little importance, made at an immense expense. The war with Scotland in the mean time was conducted feebly, and with various success. The commons granted a subsidy, to support the expenses of these two wars; but apprehensive lest more demands should be made upon them, they endeavoured to save themselves, by bestowing on the king all the revenues of the universities, as well as of the free chapels and hospitals. Henry, however, though pleased with a concession which increased his power, took care to acquaint the universities, that he had no intention to deprive learning of its endowments; and it is to his generosity, not to any protection afforded by his prostitute parliament, that these celebrated establishments owe their existence.

Having concluded a peace with France and Scotland, Henry turned his attention to domestic affairs, and particularly to his favourite object of promoting religious uniformity. The hopes of the reformers, who had been rather discouraged by the severe law of the six articles, were revived considerably by some of his measures. He permitted the litany to be celebrated in the vulgar tongue; and added a prayer, to "save us from the tyranny of the Bishop of Rome, and from all his detestable enormities." He protected Cranmer in a very decided manner, from the cabals of his enemies among the Popish party; and entirely withdrew his favour from Gardiner, on account of his malignant attempts to accomplish the destruction of the Queen. His tyrannical disposition, however, irritated and soured by his declining state of health, impelled him to punish, with fresh severities, all who presumed to suffer from himself, especially on the capital point of the real presence. An ulcer broke out in his leg, which occasioned him extreme pain, and which, in addition to his monstrous corpulency, at once threatened his life, and rendered him more than usually passionate and untractable. He became more and more outrageous as his end approached; and the cruelty of his temper seemed to increase, in proportion as his power of exercising it drew nearer to its termination.

The last objects of Henry's cruelty and injustice, were the Duke of Norfolk, and his son the Earl of Surrey; the former the most faithful of the king's ministers, and the latter the most accomplished of the English nobility. Their greatness, and not their guilt, excited the workings of the tyrant's violent and jealous spirit. The great power of Norfolk, his attachment to the ancient religion, and his alliance to the throne, suggested to Henry's mind that, during his son's minority, great danger might arise, both to the public tranquillity, and to the new ecclesiastical system, from the attempts of so potent a subject. These suspicions were increased by some unguarded expressions used by Surrey, when he was recalled from the government of Boulogne, by his refusal of all matrimonial connections that had been proposed to him, and by an apprehension that he entertained the ambitious view of espousing the Princess Mary, as a step to the crown. Disdained also with the whole family, on account of the conduct of Catherine Howard, he yielded the more readily to his vindictive feelings, and, determined upon the ruin of the two noblemen, he gave private orders to arrest and commit them to the Tower on the same day. Surrey, accused of entertaining Italian spies in his family, of holding a secret correspondence with Cardinal Pole, and of manifesting his aim at the crown, by having the annex of Edward the Confessor on his escutcheon, was without proofs, and in defiance of his able defence, condemned and executed for high treason. No greater crime could be discovered against Norfolk, than his once saying, that the king could not hold out long, and that the kingdom was likely to fall into disorders, through the diversity of religious opinions; but a bill of attainder nevertheless was passed against him in the House of Peers, without any species of trial; and the king hastening it through the House of Commons lest his victim should escape, issued the death warrant with all possible expedition. But his own death on the evening preceding the day of execution, procured a reprieve to the noble prisoner; and it was not thought advisable to commence a new reign with the sacrifice of the greatest subject in the kingdom.

Though the king's end had for several days been evidently approaching, none of his attendants dared to inform him of his condition. But Sir Anthony Denny having at length ventured to make the solemn intimation, Henry expressed his resignation, and ordered Cranmer to be brought to him. The king was speechless before
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that prelate arrived; but, being desired to give some sign of 
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His character.

Henry was very tall, strong, stately in his air, and in 
his youth uncommonly handsome, excelling in all manly 
exercises, fond of magnificence, and full of personal 
courage. He possessed great vigour of mind, and was 
distinguished by an extensive capacity. He was skilled in 
music, and spoke with fluency several foreign languages, 
particularly Latin and French. He was sincere, frank, 
liberal, and capable at least of temporary friendships and 
attachments. But his vices were of the darkest hue, and 
comprehend all the worst qualities of human nature. A 
violent impetuosity of temper, an insatiable love of pleasure, 
and a radical cruelty of disposition, were the distin-
guishing features of his mind, and the sources of his 
greatest crimes, of his profusion, rapacity, injustice, ob-
stacny, arrogance, caprice, bigotry, and tyranny. He 
was filled with an extraordinary conceit of his own supe-
rior wisdom, and fond of flattery; uncontrollable in his 
desires, and inflexible in his purposes; never known to 
yield or to forgive; and never "sparing," as he said of 
himself, "a man in his anger, or a woman in his lust." 
Yet, in spite of his cruelty, extortion, and arbitrary go-
vornment, his exterior qualities so captivated the multi-
tude, that he not only acquired the regard, but in some 
degree possessed to the last the affection of his subjects. 
He had indeed so completely subdued their free spirit, 
that, like eastern slaves, they admired those arts of 
tyranny which degraded themselves; and had he not, by 
promoting their liberation from papal oppression, pro-
duced a corrective for his own despotism, it may be fairly 
questioned, whether the English constitution would ever 
have recovered from the repeated checks which its radical 
principles sustained in his reign.

Accession of Edward VI.

Edward VI. succeeded his father as king of England 
when he was only nine years of age; but, by the will of 
Henry, the government of the kingdom, till the Prince 
should have completed his 18th year, was intrusted to 
sixteen executors, and twelve counsellors, whom he him-
self had expressly nominated, and whom he seems to 
have expected to prove equally obsequious after his 
death as they had been during his life. Their first act, 
however, was to choose a protector of the realm, who 
might represent the royal majesty, and the choice fell upon 
the Earl of Hertford, who was the young king's maternal 
uncle, and naturally interested in his nephew's safety, 
while he himself possessed no claims to the throne, which 
could endanger the Prince's person, or the public tran-
quillity. Created Duke of Somerset, he procured a pa-
tent from the young king, by which he overturned the 
will of Henry VIII. and secured to himself as regent the 
full regal power. He had long been regarded as secret-
ly favourable to the principles of the reformers; and, as 
soon as his authority was established, he openly avowed 
his intention of correcting all the abuses in the former 
system. The alterations, indeed, made by Henry, were 
rather acts of separation from the Pope, than of reforma-
tion from Popery; but now the errors of Rome began to 
be actually removed, and the history of Edward's reign 
becomes rather a detail of the methods employed by his 
governors for reforming religion, than a description of 
political measures, or warlike events.

The protector took care, that all who were entrusted 
with the education of the young king should be attached 
to the principles of the Reformation; and, in all his 
schemes for correcting the errors of popery, he had re-
course to the counsels of Archbishop Cranmer, a person 
of the greatest moderation and prudence. They experi-
cenced considerable opposition from Gardiner, Bishop of 
Winchester, which at length drew upon him the in-
dignation of the council; and he was committed to the 
Fleet-prison, where he was treated, not, indeed, with 
the cruelty of papish persecutors, but with very unbecom-
ing severity. Visitors, consisting of ecclesiastics and laymen 
united, were sent to all the dioceses, with power to cor-
rect the irregularities of the clergy, to abolish ancient 
superstitions, and to bring the worship and discipline of 
the church nearer to the practice of the reformed. Or-
ders were issued to restrain the monks, who had been 
placed in the vacant churches, from preaching in defence 
of the old abuses; and twelve homilies were published, 
which the clergy were enjoined to read to the people, 
instead of addressing them in discourses of their own 
production. The protector, having made due provision 
for the stability of affairs at home, resolved to prosecute 
the war with Scotland, in order to accomplish the pro-
ject of the late king, for uniting the two kingdoms by 
the marriage of Edward and Mary; and, with an army of 
18,000 men, attended by a fleet of sixty sail, he ad-
vanced within sight of the Scottish capital. Having routed 
the army of the Scots at Pinkie with great slaughter, 
and appointed commissioners at Berwick to treat of a 
peace, he returned to London, with that increase of pop-
ularity and power, which a conqueror, it has been ob-
served, is always sure to acquire with the English na-
tion. To this character, however, he added more esti-
mate and amiable virtues; was humble, affable, and ac-
cessible to the meanest subject; and was obviously in-
fluenced in his general conduct by the principles of reli-
gion and honour. Having summoned a parliament, he 
abated the rigour of many former statutes, and particu-
larly abolished the law, by which the king's proclama-
tion was made of equal force with an act of parliament. 
The dawn, both of civil and religious liberty, began to 
rise upon the English nation; and the gradual refor-
mation of papal corruptions, continued to be carried on 
with prudent perseverance. Various superstitious prac-
tices were abolished; all images removed from the 
churches; private masses prohibited; and auricular con-
fession, hitherto accounted an indispensable duty, and 
always one of the most powerful engines of a corrupted 
church, was pronounced a matter of indifferenc, which 
the people might observe or omit, according to their own 
choice. The government of the kingdom became in a 
great measure aristocratical, in consequence of the late in-
crease of possessions which the nobles had acquired; and 
great distractions prevailed in the state. Lord Seymour, 
a man of insatiable ambition, and possessed of distin-
guished abilities, had recently married the queen dow-
ager, and by this alliance became the rival in power of 
his brother the protector. A contest between their wives, 
on the subject of precedence, created a breach be-
tween them, and the whole court and kingdom were di-
vided by their opposite cabals and pretensions. Sey-

Cabals and execution of Lord Seymour.

mour discovered his intriguing spirit and ambitious 
views, by the most rash and criminal conduct, by using 
unwarrantable means, during the protector's absence 
in Scotland, to captivate the affections of the young 
monarch, by making a direct attack upon his bro-
 ther's authority as unconstitutional, in as much as he
if an universal conspiracy had been formed, rose at once in several parts of the kingdom. It was only in Devonshire and Norfolk that they assumed the appearance of a regular army, and became formidable by their numbers. In the former county, one thousand rebels were cut to pieces by Lord Russel, and two thousand in the latter by the Earl of Warwick. Their leaders were tried and executed at London, and many of the inferior class put to death by martial law. Those that escaped, threw down their arms upon the offer of pardon; and a general indemnity was soon after published by the protector.

But while these tumultuary insurgents were thus quickly subdued, the factions in the council, under the artful management of Warwick, became daily more formidable to the protector. Somerset, rated with his high dignity, had paid too little attention to the opinions of the other executioners and counsellors, and discovered a disposition to govern every thing according to his own views. The nobility and gentry were in general displeased with the preference which he seemed, in the late commotions, to have given to the claims of the people. The people themselves, being much influenced by the Catholic party, and ascribing many of their distresses to the Reformation, of which he was the open patron, were not heartily affected to his authority. His interest being at length overpowered by the increasing power and influence of one of his immediate predecessors, and to submit to the most humiliating conditions; Warwick, the new protector, having made peace with Scotland and France, gave full scope to his aspiring and avaricious disposition. Finding that the principles of the Reformation had sunk too deep into the mind of Edward to be easily eradicated, he resolved to comply with the prince's inclinations, and pushed the cause of the Protestants with more zeal and violence than had ever been done by his predecessor. Many of the bishops, who favoured the Catholic tenets, were treated with great severity; several of them deprived of their sees, and others obliged to secure protection, by sacrificing the most considerable part of their revenues. An order was issued by the council for purging the libraries at Westminster and Oxford of all superstitious volumes; and much useless devastation was committed in the execution of these instructions. The council, however, were not inattentive to the interests of the public; and, by their wise regulations, excited a spirit of industry and commerce, hitherto unknown in England. But the ungovernable ambition of Warwick again involved the kingdom in domestic troubles. He procured for himself the title and ample possessions of the Duke of Northumberland. He found means to accomplish the condemnation and death of Somerset, and many of his friends, as the chief obstacles in his career. He summoned a new parliament, and took care, by the most arbitrary interference, to have such members returned as were obsequious to his will. He brought about a marriage between Lady Jane Gray and his fourth son, Lord Guilford Dudley; and, at the same time, fortified his family by other powerful alliances. He then proceeded, with his last project, to prevail with the young king, whose health was declining fast, to make such a change in the succession as would have brought forward his own daughter-in-law, Lady Jane, as next heir to the crown. The prince, accustomed to submit to his views, and anxious to secure a Protestant successor, agreed to refer the matter to the council; and at length, after many ob-
the intrigues and menaces of Northumberland prevailed.

After this settlement of the crown upon the heirs of the Duchess of Suffolk, the young king’s health visibly declined every day. By the advice of Northumberland, supported by an act of the council, his physicians were dismissed, and an ignorant old woman entrusted with the care of his health. Under her management, his worst symptoms rapidly increased, and he expired at Greenwich, in the 16th year of his age, and the 7th of his reign. He possessed great mildness of disposition, united with a sagacity far above his years; and had made attainments in learning which astonished all with whom he conversed. Amidst the struggles for power among his ministers, he was merely the instrument of their mutual resentment and intrigues; but he never signed the orders of execution against any party, without tears in his eyes. His young mind was deeply tinctured with the principles of sound religion; and his many virtues rendered him an object of tender affection to his subjects, who had soon reason to lament the short duration of his promising reign.

By the decease of Edward, there were four female claimants to the crown; Mary, the eldest daughter of Henry VIII. by Catherine of Spain, and the first in succession by her father’s will; but whose illegitimacy had never been repealed; Elizabeth, Henry’s second daughter by Anne Boleyn, who had also been declared illegitimate, but whose attachment to Protestant principles might otherwise have rendered her more acceptable to the nation; Mary, Queen of Scotland, descended from Henry’s eldest sister, whose legitimacy could not be questioned, but who had been passed over in Henry’s will; and Jane Grey, the daughter of Henry’s youngest sister, whose mother, by that monarch’s will, came next to her own daughter, and who, by the will of the late king, had been preferred before them on the ground of their illegitimacy. The title of Mary, however, always esteemed the most natural and just, had been by her father’s will rendered legal and parliamentary; and during the whole of Edward’s reign, she had been uniformly regarded as his lawful successor. The Protestants, indeed, had reason to dread the effects of her religious prejudices; but the general hatred entertained against the Dudleys, counterbalanced this ground of objection. Mary, also, had the policy to promise to her adherents, that she would make no change in the laws of Edward respecting religion; and her pretensions were thus the more readily admitted by the nation at large. Northumberland, nevertheless, resolved to enforce the will of the late king in favour of his daughter-in-law; and having failed in his schemes to bring the two elder princesses into his power, caused Lady Jane to be proclaimed queen. Ignorant of the previous political transactions, attached to elegant literature, and satisfied with enjoying the affections of a husband deserving of her esteem, her heart had never opened to the allurements of ambition, and she resisted, as criminal and hazardous, her proposed elevation to the throne; but, overcome by the intrigues of her relations, she submitted at length, in opposition to her own judgment and wishes. In the mean time, the partisans of Mary were daily increasing. Lord Hastings, who had been sent to oppose her claims, revolted to her side with 4000 men; Northumberland himself was deserted by his soldiers on their march; and the council, whom he had treated as his prisoners, hastened, upon his departure from London, to declare against him. Suffolk, who commanded in the Tower, finding resistance fruitless, opened the gates to the friends of Mary; and Lady Jane Grey, resigning the crown, which she had held only ten days, gladly returned to that private station which she had never desired to leave. Northumberland, despairing of success, joined with apparent satisfaction in the proclamation of Mary at Cambridge; and she soon entered London with the most sensible expressions of loyal attachment on the part of her subjects. Northumberland was immediately arrested, capitaly convicted, and soon after executed, together with Sir John Gates and Sir Thomas Palmer, two infamous instruments of his ambitious and tyrannical measures. Sentence was, at the same time, pronounced against Lady Jane Grey and her husband Lord Guilford; but, without any present view of putting it in execution. Their youth and innocence (neither of them having reached their 17th year) pleased sufficiently in their behalf; and Mary was desirous, in the beginning of her reign, to acquire popularity by the appearance of clemency. No other blood was at this time shed; and a general pardon, with a few exceptions, was granted to those who had been concerned in the late enterprise against the rights of the sovereign. But the joy arising from the succession of Mary was inexpressible. Her excellent and gracious demeanour of the queen in her first proceedings, was soon clouded by apprehensions of her hostile designs against the reformed religion. Gardiner, Bonner, Tonstal, and the other bishops, who had been imprisoned in the last reign, were reinstated in their sees; and Holgate, Archbishop of York, Bishops Coverdale, Ridley, Hooper, and Latimer, were thrown into prison. On pretense of discouraging controversy, all the preachers were silenced, except such as should receive a particular license, which, it was clearly foreseen, would be granted only to the Catholics. Cranmer having published, in strong terms, a contradiction of a report that he had promised to read the mass before the Queen, was thrown into prison, and condemned for high treason in having concurred with the friends of Lady Jane Grey; but he was reserved for a more cruel punishment. The foreign Protestants hastened to leave the kingdom; and many useful arts and manufactures which they had introduced, were lost to the nation. A parliament was assembled, in which those who hesitated to comply with the court religion declined to serve, and which consisted therefore of members favourable to Mary’s designs. Their jealousy, however, was excited by her proposed marriage with Philip, King of Spain; and, having remonstrated in strong terms against so dangerous a measure as a foreign alliance, for this act of presumption they were instantly dissolved. The new laws regarding religion were in the mean time openly put in execution by the government. The mass was every where established; the marriages of the clergy prohibited; and nearly one half of their number deprived of their livings. In addition to the discontent excited by these violent and sudden changes, the intended Spanish match produced a more general apprehension for the liberty and independence of the nation. To obviate all objections, the articles of marriage were drawn as favourable as possible for the interest and security of England; but as it was naturally concluded that all conditions would soon be violated whenever it suited the emperor’s views, the publication of them gave no satisfaction to the people. The nation became so alarmed by the terror of Spanish tyranny, that a general rebellion was threatened; and there needed only encouragement from some foreign power, or the ap-
England.

The appearance of some person of rank as a leader, to overturn the authority of Mary. A partial insurrection broke out in Kent, headed by Sir Thomas Wyatt, a Roman Catholic, who issued a declaration against the Spanish match, and the queen's evil counsellors, without making any mention of religion, and marched to London with a body of 4000 men. But he suffered the critical season to elapse; and his partizans, upon discovering that he was not joined by any person of note, deserted rapidly from his standard. Obliged to surrender at discretion, he was tried and executed. Great cruelty was exercised against his followers. Four hundred and nineteen of them were hanged, drawn, and quartered, and many of the executioners; and the same number were conducted before the queen, with ropes about their necks, to receive a pardon on their knees. The Princess Elizabeth, and her lover the Earl of Devonshire, were committed to the Tower, upon suspicion of having been concerned in the plot; but as Wyatt had acquitted them by a solemn declaration upon the scaffold, of all share in his rebellion, it was found impracticable to proceed farther against them, except to retain them both in custody. The Duke of Suffolk having made an unsuccessful attempt, at the same time with Wyatt, to raise the midland counties, his daughter, Lady Jane Grey, and her husband, who still remained under the sentence formerly pronounced against them, were ordered to prepare for death; and the council, dreading the compassion which their youth, beauty, innocence, and noble birth might excite in the hearts of the people, gave directions that they should be beheaded within the limits of the Tower. The Duke of Suffolk was soon after brought to the scaffold. Lord Thomas Grey, Sir John Throckmorton, and many of the persons of distinction, suffered on the same account. The late rebellion furnished the queen with a pretence for exercising the native cruelty of her disposition; and her vengeance was directed against many of the nobility and gentry, more on account of their interest with the nation, than any appearance of their guilt. Finding that she had become the object of universal hatred to her subjects, she determined to disable them from future resistance, and ordered them to be mustered in different parts of the kingdom, and to be deprived of their arms.

The authority of Mary was much increased by the suppression of Wyatt's rebellion; the emporer had sent 400,000 crowns to be distributed, in bribes and pensions, among the members of parliament; and the queen had removed all alarm regarding the restoration of the church lands, by assuming the title of supreme head of the church, which she had dropped some time before. But while the parliament readily ratified the articles of marriage, which were drawn so favourably for England, they refused to pass a preamble, by the chancellor, investing the queen with a power of disposing of the crown, and appointing her successor; but, on the contrary, made such enactments, as effectually precluded Philip from possessing any authority in the government of the kingdom. They refused also to revive the law of the six articles, and to pass certain bills against heresy; and the queen finding that they would not sufficiently serve all her purposes, finished the session by dissolving them.

Mary's whole thoughts were now occupied with the completion of her marriage with Philip; and she discovered all the impatience of the youngest and fondest lover for his arrival. Her health, and even her understanding, were visibly impaired, by her extreme anxiety; and she at last became apprehensive, lest her person should be so injured by time and sickness, as to become disagreeable to her future consort. News at length were brought of his arrival at Southampton, and they were married a few days after at Westminster. They made a pompous entry into London, where Philip displayed his wealth with great ostentation; but his cold and haughty manners were ill calculated to remove the prejudices of the English nation against him. Mary soon found that his ruling passion was ambition; and that the only way of securing his affections was to render him master of England. Ready to sacrifice to his pleasure the interest and liberty of her people, she summoned a new parliament; and the influence of Spanish gold, the zeal of the Catholics, the powers of the prerogative, procured a House of Commons sufficiently compliant. Both houses, upon the representation of Cardinal Pole, who had come to England in the capacity of legate, addressed the King and Queen, professing their desire to be reconciled to the apostolical see, and requesting their intercession with the holy father for their absolution. Their request was easily granted, and the parliament and kingdom were formally re-admitted into the bosom of the church. But while they repealed all former statutes enacted against the Pope's authority in England, they took special care to secure the plunder which they had made from the ecclesiastics, and to retain possession of all the abbey and church lands. Having thus made provision for the safety of their own estates, they became very indifferent about the interests of religion, or the lives of their countrymen; and readily revived all the old sanguinary laws against heretics, placing the national religion nearly on the same footing as at the death of Henry VIII. But, with all their submission, they still preserved a regard to national independence; and resisted all proposals to put the administration into the hands of Philip, to declare him presumptive heir of the crown, or even to assist his father by subsidies in his war against France. The Queen, however, in her extreme desire to have issue, mistaking the commencement of a dropsey for a state of pregnancy, great rejoicings were made in the prospect of an heir to the throne; and the parliament passed a law, which, in case of the Queen's decease, appointed Philip protector during the minority; but, resisting all farther concessions in his favour, they were unexpectedly dissolved.

It was now frequently debated in the council, whether the laws, lately revived against heretics, should be put in execution, or merely employed by way of terror, as a restraint upon the more turbulent and obtrusive. Cardinal Pole, though firmly attached to the Catholic tenets, strongly recommended a toleration of the Protestants; but Gardiner, though suspected of less sincerity in his religious principles, keenly contended for the expediency of a violent persecution.

The arguments of the latter being more agreeable to the cruel bigotry of Mary and Philip, it was determined to enforce the laws in all their rigour against the reformed religion; and England was for three years filled with scenes of horror, which disgraced human nature, and rendered the Catholic system an object of general detestation. It has been computed, that, during the above mentioned period, 277 persons were brought to the stake; besides those who were punished by imprisonment, fines, and confiscation. Among those who suffered by fire, were 5 bishops, 21 clergymen, 8 lay gentlemen, 84 tradesmen, 100 servants and labourers, 55 women, and 4 children. Those persons,
too, were not convicted of publicly teaching tenets contrary to the established religion; but were seized upon suspicion of heresy, required to subscribe the Roman articles of faith, and were generally condemned for refusing to acknowledge the doctrine of the real presence. Among the chief sufferers, were Hooper, Bishop of Gloucester; Rogers, Prebendary of St. Paul's; Ridley, Bishop of London; Ferrar, Bishop of St. David's; Latimer, Bishop of Worcester; and Cranmer, Archbishop of Canterbury. The principal agent in these barbarities was Bonner, Bishop of London, upon whom Gardiner had devolved the invidious office; a man of profligate manners and brutal disposition, who seemed to rejoice in the torments of the unhappy sufferers, and who frequently applied the most cruel punishments with his own hands. Repeated orders were sent from the council, to quicken the diligence of the magistrates in searching out heretics; and, in some places, the entry were constrained to countenance, by their presence, the barbarous proceedings against the unhappy victims. An attempt even was made to introduce the inquisition into the country. But all those instances of cruelty and oppression were so abhorrent to the feelings of the English nation, that they produced the very opposite effect of what was intended; rendered the Spanish government daily more odious; and forwarded, instead of checking, the progress of the new opinions.

The effects of the public discontent appeared even in the next parliament that was summoned; and the Queen's application for a subsidy, and for additional enforcements of persecution, was resolutely rejected. Philip, in the mean time, finding his authority in England extremely limited, sensible of the general hatred which he had incurred, and tired by the Queen's impertinent love and jealousy, went over to Flanders, where he continued to spend most of his time, and seldom took any notice of his consort's fond epistles, except when he had occasion to demand a supply of money. In order to gratify his wishes, Mary had recourse to all the violent and irregular expedients of loans, levies, and similar extortions; and, at the same time, engaged the council, not, however, without the most vehement importunity and menace, to declare war in aid of Spain against France. This measure involved the nation in new difficulties; and the town of Calais, which had been held by England above 200 years, having been taken by the French, the whole kingdom was filled with murmurs and complaints against the improvidence of the Queen and her councillors. The Queen herself, who had been long in a declining state of health, conscious of being hated by her subjects, deplored the loss of Calais, apprehensive, in the prospect of Elizabeth's succession, for the safety of the Catholic faith, and overwhelmed with grief on account of her husband's determination to reside in Spain during the remainder of his life, fell into a lingering fever, which terminated her days in the 43d year of her age, and the sixth of her reign. She possessed few qualities, that were either estimable or amiable; and her person was as little engaging as her mind. She was cruel from natural disposition, and bigotted from a narrow understanding; and, excepting the single virtue of sincerity, her character was a complication of the most odious vices, of obstinacy, tyranny, malignity, and revenge.

After the death of Mary, the Princess Elizabeth ascended the throne, in the 25th year of her age, not only without opposition, but with the joyful acclamations of the whole nation. During the reign of her sister, she had been treated with great severity, and exposed to the most imminent dangers. Mary and the Popish bishops, well aware that, upon coming to the throne, she would instantly overturn that religion, which they were using such extreme means to establish, only waited for some new insurrection, or other favourable pretext, to take away her life. Compassion for her situation rendered her an object of interest to the nation; and the difficult part which she had to act, insured her to that exercise of prudence which qualified her to reign. Debarring also, by her confinement, from seeking amusement abroad, she applied herself to the pursuit of knowledge at home; and improved her understanding by the study of languages and science. She entered London amidst crowds of people, who strove with each other to give her the strongest testimonies of their affection; and when she reached the Tower, where she had formerly been exposed to all the bigotted malignity of her enemies, she gave thanks on her knees to the Almighty, for her deliverance from bloody persecutors; but this was the only instance in which she testified her recollection of past injuries, and with a magnanimity truly laudable, she received, with affability, even those who had treated her with the greatest malignity. When the bishops, however, came to explain their hommage, she turned aside from Bonner as from a man polluted with blood, and as it just object of horror to every friend of humanity. Immediately after her accession, she received proposals of marriage from Philip of Spain, who still hoped to obtain, by her means, that dominion over England, of which he had been disappointed in espousing Mary. But Elizabeth, neither attached to the person nor to the religion of her admirer, and sensible of the aversion which her subjects entertained to the Spanish influence, declined his addresses; yet in such an evasive manner, that for some time she retained hopes of success, and even took measures for procuring a dispensation from the Pope for the match.

The young queen, who had formed a determination, even amidst the restraints of a prison, to reform the church, upon her coming to the throne, proceeded without delay, in conjunction with Sir William Cecil, her secretary of state, to concert measures for restoring the Protestant religion; and as the cruelties exercised in the last reign had completely alienated the people from the ancient faith, it became a very easy matter to accomplish this object. Resolved, however, to proceed by secure and gradual steps, she checked the furious attacks of the Protestant teachers on the Romish superstitions, by prohibiting all preaching without a special licence, and by exempting from this restriction only the more moderate and judicious of her own party; and made no other innovations in the form of worship, except to forbid the elevation of the host, and to cause the greater part of the service to be read in English. At the same time, she clearly indicated her intentions of supporting the Reformation, by recalling the Protestant exiles, and setting at liberty all prisoners who were confined on account of religion; but delayed the entire change of the national faith till the meeting of the parliament, which was summoned to assemble, and in the elections for which the Catholics scarcely struggled for the superiority. After recognizing the queen's title to the throne, they annexed the supremacy of the church to the crown; confirmed all the statutes enacted in King Edward's reign with regard to religion; and, in one session, without violence or clamour, altered the whole public system of religion, nearly to the very state in
which it is at present established. Thus did England change its religious tenets four times in the space of 92 years; but, in this last instance alone, without compulsion. The people were now Protestants from inclination, chiefly in consequence of the persecutions under Mary; and out of 9400 benefited clergymen throughout the kingdom, only 14 bishops, 12 archdeacons, 15 heads of colleges, and about 80 of the parochial clergy, quitted their preferments on account of the Reformation.

Elizabeth, now seated on a Protestant throne, found all the neighbouring states, France, Scotland, Spain, and the Pope, openly or secretly combined against her; and having thus no friend to aid in her emergencies, she sought her great resource in the affection of her subjects, and the wisdom of her administration. To make herself beloved by the people, and at the same time feared by her courtiers, became therefore the governing maxims of her conduct. By frugal management of the national treasure, and by the most gracious affability in her public appearances, she acquired a degree of popularity, which no other English sovereign ever attained; and by a sparing distribution of gifts to her favourites, together with strict impartiality in dispensing rewards or punishments, she kept the great in sufficient subjection. Her chief minister was Robert Dudley, son of the late Duke of Northumberland, to whom she cherished an attachment, for which, as he had neither great abilities nor virtues, it is not easy to account; but, to make amends for his incapacity, the two favourites next in power were Bacon and Cecil, men of the highest talents and most indefatigable application, who regulated the finances of the kingdom, and directed all the great political measures of her reign.

While measures were pursuing for settling the public religion at home, negotiations were, at the same time, going on for peace with France; and a treaty was at length concluded, by which it was stipulated, that the French monarch should restore Calais at the end of eight years; that, in case of failure, he should pay 500,000 crown; and the queen of Scots still retains; and that, if Elizabeth broke the peace with France or Scotland during the interval, she should forfeit all claims to Calais; and that if the king of France made war on England during that time, he should be bound immediately to restore that fortress. A peace with Scotland was the natural consequence of that with France; but a serious ground of quarrel soon arose between the English and Scottish queens, which was attended with the most important consequences, and which was removed only by the death of the latter. The birth of Elizabeth was liable to the charge of illegitimacy, and the next heir of blood to the English throne was the queen of Scots, now married to the dauphin of France. The French king had been secretly soliciting at Rome, a ball of excommunication against the daughter of Anne Boleyn; and Mary had been persuaded to assume openly the arms and title of England. This was vindicated by her descent from the blood royal, and by the example of other princes; but, as it had not been done during the reign of Mary, Elizabeth considered it as indicating an intention to dispute, on the first opportunity, the legitimacy of her birth, and the validity of her title to the crown. Hence, she conceived a violent jealousy against the queen of Scots, as at once her most formidable rival and mortal enemy. Determined, as far as possible, to incapacitate her opponents from executing any project against her, she readily listened to an application from the Scottish reformers, for assistance against the French party in that kingdom; and by the most prompt and powerful succours, soon secured an honourable and advantageous treaty for herself and her friends. It was stipulated, that the French should evacuate Scotland, and that the queen of Scots should abate from bearing the royal arms of England; while, at the same time, by procuring favourable terms for the Scottish Protestants, she continued to possess a stronger influence over them, than their native sovereign was ever able to acquire. But Mary, afterwards refusing to ratified the treaty, and thus to make a formal renunciation of her pretensions, unless she was declared to be next in the succession to the English crown, and Elizabeth determined never to assist in any respect in strengthening the claims of so formidable a rival, the two queens, amidst all the appearance of cordial friendship, continued to entertain a perpetual jealousy of each other's intentions.

In the mean time, Elizabeth, leaving the queen of Scots, sufficiently occupied with domestic concerns, turned her attention to regulate the affairs of her own kingdom, and to promote the prosperity of her subjects. She adopted measures for paying off the debts of the crown, and reformed the coin which her predecessors had debased; furnished her armies with military stores, and provided for the general defence of her dominions; encouraged agriculture and commerce, by wise regulations; and particularly exerted her endeavours to increase the naval power of the kingdom. She bestowed great encouragement also upon the seminaries of learning; and set an example of moderation and justice to the Catholic party, by providing for the more faithful payment of the pensions, which had been granted to the dispossessed monks, but which had hitherto been in a great measure neglected. Powerful at home, and respected abroad, she received numerous proposals of marriage, both from surrounding princes, and from the more eminent of her own subjects. The Arch duke Charles, second son of the Emperor; Casimir, son of the Elector Palatine; Eric, King of Sweden; Adolph, Duke of Holstein; the Earl of Arran, heir to the crown of Scotland; the Earl of Arundel, distinguished by his nobility and wealth; Sir William Pickering, a man much esteemed for his personal merit; and, above all, Robert Dudley, Earl of Leicester, were all competitors for her hand; but, while she publicly declared her resolution to lead a single life, she gave to all her suitors such gentle refusals, as generally encouraged them to persevere in the pursuit; and this she has been supposed to have done partly from motives of policy, to keep them more attached to her interests, and partly from taking pleasure, as a woman, in receiving professions of love. While thus apparently determined to have no heir of her own body, and avoiding carefully to fix any successor to the crown, she seems to have also resolved, either from policy or malignity, to prevent every one, who had pretensions to the throne, from having either heirs or successors. Lady Catherine Grey, youngest sister of Lady Jane, and now the nearest claimant, after the queen of Scots, to the throne of England, having privately married the Earl of Hertford, without the consent of Elizabeth, they were both committed to the Tower in separate prisons, where they suffered ten years of severe confinement; till the death of the lady, by removing the unrelenting jealousy of the queen, procured the liberty of her husband. A similar anxiety to prevent the marriage of the queen of

Elizabeth's wise and vigorous administration.
Scots, excited new contests with that rival princess, in which the treachery and cruelty of Elizabeth's prince cannot be justified; though it must be admitted, that the fears which impelled her proceedings were not without foundation, and were too often alarmed by the rashness of Mary's friends. During her illness, and consequence of the small-pox, when little hopes were entertained of her recovery, the partizans of the Scottish princess, and those of the House of Suffolk, already divided the nation into such violent factions, that the controversy, it was evident, in case of the queen's decease, would be terminated only by the sword. The commons, therefore, as soon as her health was restored, earnestly entreated her to put an end to such apprehensions, either by choosing a husband, or by naming her successor. Elizabeth, however, afraid to declare against Mary, who clearly possessed the right of blood, and who would instantly have become her avowed enemy; and, on the other hand, unwilling, by a settlement in her rival's favour, to establish pretensions which might be enforced even during her reign, she resolved to keep both parties in awe, by an ambiguous conduct and evasive answers; and chose rather that her subjects should run the risk of a civil war at her death, than that her throne should be endangered during her life. She continued, with all her vigour and policy, to avert such attempts on the part of the Popish interest, by giving her enemies employment at home; and afforded every necessary succour, both to the Hugonots in France, and to the Reformers in Scotland. An event, however, happened, which placed the person and the fate of her rival entirely at her disposal; and effectually precluded all farther danger from her pretensions. Mary, queen of Scots, having been reduced, by her imprudence, if not by her guilt, to take refuge in England, and to seek the protection of Elizabeth against her own subjects, was allured, by the most plausible professions of friendship, to admit the queen of England as umpire in her cause; and being at length required either voluntarily to resign her crown, or to associate her son with her in the government, leaving the administration of affairs in the hands of the Earl of Murray, she was, upon her refusal to make such a submission, unjustly detained as a prisoner in England. Various insurrections and conspiracies, chiefly on her account, and sometimes with her concurrence; an attempt by the Duke of Norfolk, (for which he suffered on the scaffold,) to espouse and to deliver the royal captive; the open interference of the Pope, who excommunicated Elizabeth, and freed her subjects from their allegiance to her person; and particularly, a plot conducted by the Catholics to assassinate the Queen, to which Mary, irritated by confinement, and anxious for liberty, had become a party; these occurrences, and a multitude of other political considerations, induced Elizabeth to bring her unhappy prisoner to a trial, and to hasten the ruin of a competitor, whom she had never ceased to dread or to hate. Mary, who had now lingered 16 years in confinement, was accordingly condemned for high treason against the Queen of England, and beheaded in one of the rooms of her prison:—a transaction, in the course of which Elizabeth was guilty of the grossest dissimulation and most cruel injustice; and which, whatever were the crimes of the sufferer, must remain an inimitable stain upon the memory of her oppressor.

While Elizabeth was engaged in plotting the destruction of her rival, she was carrying on a treaty of marriage with the young Duke of Anjou; and, after long struggling between ambition and inclination, she was on the point of yielding to the latter, and of subjecting herself and her people to a foreign and a Catholic prince, when all her favourite attendants and ministers united in deprecating so imprudent an alliance. A letter, particularly written to her on the subject by the celebrated Sir Philip Sydney, and distinguished by unusual elegance of expression, as well as force of reasoning, is understood to have raised her to reflection; and, after spending several nights in restless anxiety, she finally determined against the match, and dismissed her lover, with proper apologies for her breach of engagement.

While Philip of Spain had been actively intriguing with the malefactors in England and Ireland in the cause of the Queen of Scots and of the Catholics, Elizabeth had been rendering powerful aid to the insurgents against his authority in the Low Countries. In retaliation for this interference, he sent, under the name of the pope, a body of 700 Spaniards and Italians into Ireland, where the inhabitants, discontented with the English government, were ready to join any invader; but by the active measures of the Earl of Ormond, they were soon reduced to the necessity of surrendering at discretion. The queen of England, on the other hand, countenanced the predatory attacks of Sir Francis Drake upon the Spanish settlements in South America; and, by those mutual aggravations, the two nations were at length brought to an open rupture. Elizabeth, in the view of an approaching war with so powerful an antagonist, concluded a league of mutual defence with the king of Scotland; and hearing that Philip was secretly preparing an immense fleet for the invasion of her kingdom, she resolved to strike the first blow, and to brave his boasted naval force in his own harbours. Sir Francis Drake was immediately dispatched with a strong squadron, which the London merchants had assisted to equip, in the hopes of sharing the plunder; and, sailing direct to Cadiz, he destroyed about a hundred vessels laden with ammunition and stores. By this short expedition, the intended invasion of England was retarded a whole twelvemonth; and the English seamen were taught to despise those unwieldy vessels of the enemy, which were threatening to spread terror along their coasts. The preparations of Philip, who meditated nothing short of the entire conquest of England, were carried on with redoubled vigour; and the Spaniards, confident of success, had already denominated their navy the Invincible Armada. Elizabeth, on her part, exerted her utmost prudence and vigour to resist the danger with which she was threatened; and employed all the resources which her domestic situation, or her foreign alliances, could afford. By all the Protestants of Europe, the enterprise was considered as decisive of their fate; and those who could give no assistance, contemplated, with anxious interest, the approaching struggle. The people of England, animated by the spirited example of their sovereign, manifested the most determined resolution to defend their religion and their liberties; and even the Catholic subjects, treated by the queen with generous moderation, forgetting for the present all party concerns, united with one heart in defence of the common cause. The armada at length set sail from Lisbon, and entered the Channel in the form of a crescent, which extended its two extremities to the distance of seven miles; but, completely baffled in its first attempts by the skill and courage of the English navy, gradually weakened by their daring and repeated attacks, and finally overtaken by a dreadful storm when passing the Orkneys, this mighty armament was so ut-
terly discomfited, that not one half of its ships returned
to Spain, and nothing but want of ammunition in the
English fleet saved it from total destruction: (See the
article ARMADA.) This defeat of the armada inspired
the English nation with a kind of enthusiastic passion
for enterprises against Spain; and scarcely a single year
was suffered to elapse without some successful attack
being directed against the dominions of Philip. In
1596, particularly, a powerful expedition was fitted out
against Cadiz, which defeated the Spanish fleet in the
bay, took the city by storm, and destroyed in the har-
bour a fleet of merchant ships of immense value. It
was in this reign, and by these enterprises, that the
English navy began to acquire that irresistible superior-
y which it has never ceased to maintain, and that
many of its most able and adventurous commanders
were produced. In this reign, also, notwithstanding
the imperious character of the sovereign, the spirit of
liberty, following the progress of reformation in reli-
gion, presumed to show itself in the proceedings of the
English parliament. Elizabeth, indeed, was sufficiently
tenacious of all her prerogatives, and frequently exercis-
et them with a degree of despotism unequalled by
many of her predecessors. She repeatedly discharged
the House of Commons from discussing, without her
permission, any matters relating either to the church or
the state; defined their liberty of speech to extend no
further than aye or no; and, without hesitation, com-
mited to the Tower every member who presumed to
press any topic contrary to her wishes. But amidst
the tamest submissions and most fulsome flatteries from
successive parliaments, a few resolute individuals, (who
have generally been branded with the contemptuous
name of Puritans, while they deserve to be revered as
the fathers of British freedom,) persisted, without dis-
may, in ascertaining public grievances, and asserting par-
lamentary privileges, whenever they could procure
the smallest support; and so far at length did their spi-
rit and numbers increase, that, in the last parliament
which Elizabeth assembled, she found it necessary,
while she held the most absolute tone in her messages,
to abandon, in a great measure, the oppressive system
of monopolies, which she was accustomed to grant as
rewards to her courtiers, and which the Commons had
brought in a bill to abolish.

Though the signal advantages gained by the arms of
Elizabeth over the Spaniards, and the uncontrolled
authority which she exercised over her own subjects,
gave complete security to her throne, she continued
to regard her heir, the king of Scotland, with the
same malignant jealousy which had influenced her
conduct towards the unhappy Mary. James had, in-
deed, succeeded to all the claims of his mother; but,
as a Protestant prince, he did not possess the fa-
vour of the Catholics, which could render his preten-
sions dangerous; and his indolent, unambitious dispo-
sition, sufficiently secured her from any disturbance in
the possession of the crown. Still, however, she cau-
tiously abstained from satisfying the nation by any de-
claration in favour of his title; and was as anxious to
prevent every circumstance which might augment his
credit or power, as if he had been her immediate com-
petitor for the kingdom.

The authority of the English in Ireland had been hi-
thero little more than nominal; and the complete sub-
jugation of that country had been always deferred, by
the necessity of watching the more formidable powers
of the continent. But the rebellion in that kingdom
having now risen, under the conduct of the Earl of
Tyrone, to a more alarming height than at any former
period, and the Spaniards having exerted themselves, as
the most effectual mode of diverting the power of the
English from their coast, in sending succours to the
natives, it was therefore resolved to push the war in
that quarter with more vigorous measures; and the
young Earl of Essex, who had succeeded, since the
death of the Earl of Leicester, to the queen’s favour,
obtained the government of Ireland, and the command
of the army destined for its reduction. Having disgust-
et the queen by his ill success and insolent behaviour,
he returned suddenly to England to make his peace at
court; but Lord Mountjoy, who was then appointed as
deputy-governor to the command, by his able and
indefatigable exertions, defeated the rebels in every quar-
ter, and at length compelled Tyrone to make an absol-
ute surrender of his life and fortunes to the queen’s
mercy.

Essex, in the mean time, who had long possessed a
powerful hold of Elizabeth’s affections, but whose un-
governable spirit she found it requisite to humble, was
brought to trial before the privy-council, and condem-
ed to retirement in his own house, till the queen should
be pleased to restore him to office. He expressed in
his defence the most dutiful submission to his sovereign’s
pleasure; and, as Elizabeth herself had openly declared,
that her severity was intended to correct and not to ruin
him, it was generally expected that he would soon re-
gain all his ascendancy over her mind, and reappear a
greater favourite than ever. Persuaded, however, by
his enemies, that his lofty spirit was far from being sub-
dued, she pushed her rigorous treatment to a degree
which impressed him with a belief that she was alto-
gether inexorable, and drove his impatient temper to the
most fatal extremities. He threw off all appearance of
duty and respect, and even indulged himself in great
liberties of speech, respecting the queen’s advanced age
and decayed beauty. He used every art to increase his
popularity, which was already greater than what any
other subject enjoyed; and he entered into a secret cor-
respondence with the King of Scotland, whose right of
succession he proposed to compel Elizabeth to acknow-
ledge. Having formed a strong party of malecontents,
and trusting chiefly to his great authority with the
population, he formed at length the desperate attempt
of seizing the queen’s person, removing his enemies from
office, and settling, with the advice of his partizans, a
new plan of government. Finding, however, that his
designs were suspected, and the queen upon her guard,
yet determined to make some open effort before they
should be completely discovered, he adopted the wild
project of raising the city of London in his favour; and
madly imagined, that by the mere good will of the mul-
titude, he should be able to over turn the wise and well-
established government of Elizabeth. Sallying forth
in the full blaze of day, he exclaimed, ‘Tyrone, as a
queen! for the queen! a plot is laid for my life!’ he
proceeded to the house of the sheriff, upon whose aid
he placed great reliance. The citizens, in the mean-
time, flocked around him in amazement, but discovered
no disposition to join him in arms. Observing their
coldness, and hearing that he was proclaimed a traitor,
he began to despair of success, and to think of retreat-
ing to his own house. Attempting to force his way
through the streets, which were now barricaded and
watched, he was beaten back and wounded in the
thigh; but at length, by putting his followers on board
of small boats, he escaped down the river to his house,
which he proceeded to fortify in the best manner that:
he could, and proposed to defend to the last extremity.  He was soon compelled to surrender at discretion, brought to immediate trial, clearly convicted of high treason, and condemned to capital punishment. Elizabeth hesitated long between love and resentment, compassion for her favourite, and the care of her own safety. She signed the warrant for his execution; then countermanded the order; again commanded it to proceed, and again yielded to a return of tenderness in his favour. But, hardened against him at last, chiefly by his supposed obstinacy in making no application to her for mercy, she finally consented to his death. His proud heart having been humbled in the solitude of prison, not by fear, but by sentiments of religion, he made a full confession of his disloyalty, acknowledged the justice of his sentence, and testified on the scaffold the most suitable symptoms of penitence and piety.

The vigour of Elizabeth's mind and the happiness of her life seemed to expire with her favourite; and, though she went through the business of the state by habit, she took little interest in any public measure or event. She sunk at last into a profound melancholy, which nothing could alleviate, and for which various reasons have been assigned. Some ascribe this depression of mind to remorse for having been persuaded to pardon the rebel Tyrone, or for some other actions of her life; others to a discovery which she had made of the correspondence maintained by her courtiers with her successor, the King of Scotland; others to the neglect which, on account of her old age and infirmities, she now imagined that she experienced; others, to a mere decay of her faculties, in consequence of long and severe exertion of mind; and others, with more probability, to a revival of her regret for the death of Essex, whom she had given up entirely in resentment for his invincible obstinacy, but who, she now discovered, had actually thrown himself upon her clemency, while his enemies had found means to conceal his application. From the moment of making this discovery, she resigned herself to the deepest despondency, refused all sustenance and consolation, rejected all advice from her physicians, and remained sullen and immovable on the floor, venting her grief in sighs and groans. In this situation she continued for ten days and nights, leaning upon cushions which her maid brought to her; and, as her end was visibly approaching, the council sent the Secretary and Lord Admiral to know her will respecting her successor. She faintly replied, that, as she had held a regal sceptre, she wished a king to succeed her, and that her heir, therefore, could be no other than her near kinsman the King of Scots. Being then exhorted by the Archbishop of Canterbury to fix her thoughts upon God, she answered, that her mind did not in the least wander from him. She soon after fell into a lethargic slumber, which continued for some hours, and then expired without any further struggle, in the 70th year of her age, and the 45th of her reign.

The character of Queen Elizabeth varied considerably with the circumstances in which she was placed. At the commencement of her reign, she was humble and moderate; and, ascending the throne in highly difficult circumstances, she conducted the government with unsurpassed felicity and success. But she after-wards became more haughty and severe; and frequently exerted the powers of her prerogative in the most violent and oppressive manner. She possessed, indeed, the most singular talents for government; and, in point of vigour, steadiness, penetration, vigilance, magnanimity, and address, may stand a comparison with any sovereign in any period of the world. In the choice of her favourites, she was often guided by unworthy and capricious motives; but her able ministers and commanders, to whom she owed so much of the glory of her reign, if not always selected by her own discernment, were at least advanced and supported by the constancy of her friendship. Her economy was very remarkable, and enabled her, with a small revenue and few supplies from her people, to execute the greatest undertakings; but it was a virtue which she practised more from natural disposition, and a desire of being independent of parliamentary aid, than from any tender concern for her subjects. She was great, in short, as a public character; and all her stronger qualities were preserved in due subordination by her own self-command. But, in private life, she was less to be admired; and had many infirmities, which all her excellent sense and strength of mind could not overcome, and which made her most disliked and feared by those who were placed nearest to her person. Deficient in sincerity and sympathy; vain of her beauty, which she only could discover; delighted with the praise of her charms, even at the age of sixty-five; jealous of every female competitor, to a degree which the youngest and silliest of her sex might despise; and subject to sallies of anger, which no sense of dignity could restrain, her character adds one more to the many instances which occur in human life, and which are calculated to subdue human pride, of the greatest moral weaknesses united with the highest intellectual superiority. But whatever was the merit of the sovereign, the progress of the English nation in arts, arms, commerce, agriculture, and literature, during the reign of Elizabeth, is unparalleled in history. The genius of the people, if not the wisdom of the government, surmounted every obstacle; and a kingdom, formerly unsettled and stormy like the element by which it is encompassed, successively sinking under foreign invasion, or torn by domestic disputes, became industrious, enterprising, polite, powerful, secure at home, and formidable abroad. Its external commerce, by the exertions of its adventurous navigators, was pushed to the most distant quarters of the globe; and its internal manufactures, aided by the Flemish artists, who were driven from their own country by the oppressive measures of Spain, flourished beyond all precedent in every district of the country, in spite of the oppressive monopolies granted by the crown. By the progress of religious enquiries, and the perusal of the scriptures in the amended translation, the people were improved in taste as well as in morals; and though the queen herself was more vain of shining by her own learning, than liberal in the encouragement of genius, many of the nobles and higher clergy, both by their patronage and example, contributed so essentially to the improvement of the English language, that many writers have been disposed to fix its Augustan age to that period. Liberty, indeed, still continued to depend upon the pleasure of the government; but, though Elizabeth often stretched her power to actual despotism, yet the people were less absolutely submissive than in former reigns; and even under her imperious sway, those noble principles of freedom, which at length pervaded the British soil, began to spring up, and to find a shelter beneath the fostering protection of enlightened religious zeal.

Elizabeth was succeeded by James VI. of Scotland, and I. of England; and from the period of his accession, the history of both kingdoms is comprehended under the article Britain. (9)
PART II. STATISTICS.

Although an admeasurement of the maps of England and Wales, even inaccurately constructed as they were at this period, might have been sufficient to prove that the areas assigned by tradition and by Malines, were far below the truth; yet Sir William Petty, in his calculation of the extent of South Britain, reduces the number of acres, considering them as amounting only to 28,000,000. But Sir William Petty in this, as in too many other instances of political arithmetic, was satisfied with vague and loose conjecture, where he might at least have gained a near approach to truth and accuracy. It may, indeed, have happened, that Sir William Petty calculated by 60 miles to a degree of latitude; in which case, the number of acres that he assigns to South Britain will agree very nearly with Morden's map, which was the best that had been published when he wrote.

Gregory King, Lancaster herald, who published "Natural and political observations and conclusions upon the state and condition of England, 1696," which work is praised and garbled by Davenant, and has been lately republished entire by Mr George Chalmers,—calculates that England and Wales contain 99,000,000 acres; of which 12,000,000 consisted of heaths, moors, mountains, barren lands, rivers, lakes, meres, and ponds; roads, ways, and waste lands; or were occupied by houses, homesteads, gardens, orchards, churches, and churchyards. The same author calculates, that England and Wales are in proportion to the globe of the earth and seas, as one to 3,500:—to the known habitable world, as one to 600;—to Europe (including Muscovy) as one to 43;—to France, as one to three and a quarter;—to Holland, as nine to two; and to France and Holland, as one to three and a half.

It is evident, that in all these calculations of Malines, Sir William Petty, and Gregory King, political arithmetic had derived no assistance from the more sure and accurate sciences, but had been suffered to range unenlightened and uncontrolled, either by geography or geometry. At length, Dr Edmund Halley, in consequence of the earnest desire of his industrious and inquisitive friend Mr Houghton, author of the Collections for the improvement of Husbandry and Trade, made a most elaborate calculation with respect to the contents of England and Wales, which he found to contain in the gross—that is, taking the whole from a single map,—38,660,000 acres; and on a strict computation of the several counties, each separately examined, he computed the total to be 39,938,500 acres; and as these sums, attainted to by these two different methods, so nearly approached each other, he concluded that neither of them could be very wide from the truth. He adds, that, in his judgment, England and Wales might be esteemed the 3000th part of the whole globe of the earth, and the 1500th part of the inhabited world. Dr Halley's own account of his calculations is given in vol. i. p. 69, of Houghton's Collections. Besides the source of error to which the calculations of Dr Halley were exposed, from the inaccuracy of the maps of England, which existed in his time (a circumstance which will be afterwards more particularly noticed,) his estimate was rendered erroneous, by his having used (as most of our geographers still do)
ENGLAND.

Mr. Norwood's measure of a degree of latitude, instead of the true measure; or sixty-nine miles and a half, instead of sixty-nine and one fifth: had he used the latter measure of a degree of latitude, the total would have been reduced about $70,000 acres, which would have nearly coincided with the area of South Britain, as given by Morden's map, when measured according to the true length of the successive degrees of latitude and longitude;—the single map, from which Dr Halley took the gross amount, was Adam's, and the map from which he took the several counties, was the six-sheet map of Saxton's.

In the Philosophical Transactions for the year 1711, (No. 380, page 266.) are given the calculations of Dr Nehemiah Grew on this subject, and the result of these calculations. According to him, South Britain contains 72,000 statute miles, and consequently 46,005,000 statute acres. As Dr Grew was at the trouble to obtain a wheel measure of those roads, which were necessary to supply him with what he conceived to be sufficient data on which to found his calculations, it might be supposed that the area he assigns to South Britain would approach very nearly to the truth; but he unaccountably forgot, that roads are not always straight or smooth; and assuming, on the contrary, that the wheel measure of them gave him a straight line, he makes the length of South Britain, from Newhaven, in Sussex, to Berwick, 395 miles; and its breadth, from the South Foreland to Kent, to the Land's End, he makes 367 miles; both, as we shall afterwards see, considerably above the truth. Nor was this mistake respecting the roads the only source of his error; for he very carelessly and inaccurately conjectures, that a right-lined triangle, formed by uniting the South Foreland and the Land's End with Berwick, is commensurate with the space contained by the irregular outline of the country. This error would have given less than the real area to South Britain, had the sides of the triangle corresponded with the actual distances, though the amount was not sufficient to destroy the error arising from making these sides too long.

The next calculation respecting the area of South Britain, was given to the world by Mr Thomas Templeman of Bury, in his work entitled a New Survey of the Globe. According to him, it contains 49,445 square miles, or 31,648,000 statute acres. This extent, much more below the truth than the calculation of Dr Grew raised it above it, Mr Templeman obtained, by adopting a mode of computation that is progressively more erroneous, as it is applied to countries more distant from the equator. Mr Arthur Young seems to have been the first who objected to the accuracy of Templeman's calculation; but not perceiving the source from which the error of this author took its rise, he endeavours to correct it on improper grounds; and supposing that the error would be rectified by taking 694 miles instead of 60 miles to a degree, and moreover supposing, that Templeman erred as much in his calculation respecting the area of England, as the calculation of Necker respecting the area of France proved he had done with regard to that kingdom; Mr Young assigns to England and Wales 46,915,883 acres.

Amidst this uncertainty of calculation and opinion on this subject, the trigonometrical survey of England was begun; and, in its progress, it was abundantly and clearly proved, that the geography of this country, in many respects, was very erroneous. Indeed, before it was commenced, it had been discovered, that in the older maps the counties in the vicinity of the metropolis were erroneously laid down, both with respect to the general amount of their area, and with respect to the particular areas of each; so that the distance from the South Foreland in Kent, to the Land's End, was ascertained to be less by about half a degree than had been formerly laid down.

For all the purposes of political arithmetic, however, it is not necessary to have recourse to that minute accuracy which trigonometrical surveys afford. A sufficient degree of accuracy will be afforded by a mode of computation, ingenious, easy, and satisfactory, which was published by Dr Becke, in his Observations on the Produce of the Income Tax. He was naturally led to the consideration of the subject of the extent of South Britain, by the computation of the income of Great Britain, as stated by Mr Pitt in the House of Commons. This statesman had assumed the truth of Mr Young's calculation respecting the area of England, (to which Mr Middleton, in his Survey of Middlesex, had also lent the authority of his name,) and, consequently, had rated the income of this county, much too high. Dr Becke formed a scale, which is given below, the construction of which depends on the length of the degrees of latitude and longitude, according to their situation on the surface of the earth. In this scale, the number of acres and decimal parts in every successive four-sided figure, or trapezoid, are given; these trapezoids being formed by the intersection of lines, or circles of longitude and latitude, whose distance from one another is a minute, or the sixtieth part of a degree. The length of the degree of latitude and longitude, according to their situation, by which the following scale is calculated, is taken from the recent observations and measurements for that purpose, in this country, as they are detailed at large in the Philosophical Transactions.

A trapezoid, formed by drawing parallel lines across a map from east to west, and others from south to north, at the distance of the sixtieth part of a degree, contains, on an average of every ten minutes successively, the following number of acres and decimal parts.

From 40° 50' to 50° 0' 550.09 Acres.
From 50 0 to 50 10 548.88.
From 50 10 to 50 20 546.95.
From 50 20 to 50 30 545.07.
From 50 30 to 50 40 543.19.
From 50 40 to 50 50 541.31.
From 50 50 to 51 0 539.43.
From 51 0 to 51 10 537.52.
From 51 10 to 51 20 535.62.
From 51 20 to 51 30 533.72.
From 51 30 to 51 40 531.82.
From 51 40 to 51 50 529.92.
From 51 50 to 52 0 528.02.
From 52 0 to 52 10 526.09.
From 52 10 to 52 20 524.15.
From 52 20 to 52 30 522.23.
From 52 30 to 52 40 520.30.
From 52 40 to 52 50 518.37.
From 52 50 to 53 0 516.44.
From 53 0 to 53 10 514.50.
From 53 10 to 53 20 512.55.
From 53 20 to 53 30 510.60.
From 53 30 to 53 40 508.65.
From 53 40 to 53 50 506.70.
From 53 50 to 54 0 504.75.
From 54 0 to 54 10 502.78.
soils, which predominate on the eastern side of the kingdom, the increase of surface, from its irregularity or unevenness, does not amount to much more than the 1000th part; that in the hilly and chalky counties, it scarcely exceeds the 400th part; and that, making a greater allowance for Wales, Westmoreland, and other very mountainous districts, it will not collectively amount to more, at most, than between 120,000, and 150,000 acres.

The progressive geography of England and Wales. Progressive geography may be classed under four periods, which will supply us with the divisions of this country, at the time when the Romans invaded it; during their abode here; during the Saxon heptarchy; and at present.

At the period of the invasion of the Romans, the Daunamone inhabited the counties of Cornwall and Devonshire; the Durotriges, Dorsetshire; the Belgae, Somerset, Wiltshire, and the northern part of Hampshire; the Atrebati, Berkshire; the Regni, Surre, Sussex, and the south part of Hampshire; the Cantii inhabited the county of Kent; the Trinobantes, Middlesex and Essex; the Iceni, Suffolk, Norfolk, Cambridgeshire, and Huntingdonshire; the Catueuculani, Buckinghamshire, Hertfordshire, and Bedfordshire; the Dobuni, Gloucestershire, and Oxfordshire; the Silures, Herefordshire, Monmouthshire, Radnorshire, Brecknockshire, and Glamorganshire; the Dimetis, Caernarvonshire, Pembrokeshire, and Cardiganshire; the Ordovices, Flintshire, Denbighshire, Merionethshire, Montgomeryshire, Caernarvonshire, and the Isle of Anglesey; the Cornovii, Cheshire, Salop, Staffordshire, Warwickshire, and Worcestershire; the Coritani, Lincolnshire, Nottinghamshire, Derbyshire, Leicestershire, Rutland, and Northamptonshire; the Brigantes, Yorkshire, Lancashire, Westmoreland, Cumberland, and Durham; and the Ottodanes, Northumberland.

During the Roman period, England was divided into the following large provinces, the extent and boundaries of which are not, however, exactly ascertained; Britannia Prima, which comprehended the whole southern part of England, as far as the mouths of the Severn and the Thames; Britannia Secunda, which comprised modern Wales; Flavia Cesariana, which comprehended the middle of England, from the Thames to the Humber; Maxima Cesariana, in which were included a part of the northern counties, from the Humber to the Tyne, on the east side, and from the Mersey to the Solway Frith, on the west side of the kingdom. The province of Valentia seems to have comprised the remainder of the northern counties, and to have been formed and named when the province of Vespasiana, which included part of the south of Scotland, was reconquered.

During the Saxon period of the history of England, this country formed a heptarchy, or seven kingdoms, which were divided in the following manner:

Kent, comprehended the county of Kent; it was founded by Hengist, in the year 454, and terminated in the year 823.

Sussex, or the kingdom of the South Saxons, comprehended the counties of Sussex and Surrey: it was founded by Ella, in the year 491, and ended in the year 885.

The East Angles comprehended the counties of Norfolk, Suffolk, Cambridgeshire, and the isle of Ely: it was founded by Uffa, in the year 566, and terminated in the year 792.

Wessex, or the kingdom of the West Saxons, comprehended the counties of Cornwall, Devonshire, Dor-
England.

In the 10th of Edward I. the statute of Rhuddlan was passed, by which it was declared, that the territory of Wales, with its inhabitants, which had been formerly subject to the king by feudal right, was entirely annexed to the crown of the kingdom of England, as part of that monarchy. Notwithstanding this statute, however, Wales retained many of its peculiar privileges and immunities, which were not abolished till the reign of Henry VIII. By the statute 27th of that monarch, chapter 26, A.D. 1535, entitled, an “act for laws and justice to be ministered in Wales, in like form as it is in this realm,” it is enacted, that the dominion of Wales shall be for ever united to the kingdom of England;—that all Welshmen born, shall have the same privileges and liberties as the rest of the king’s subjects;—that lands in Wales shall be inheritable, according to the English tenures and rules of descent;—(before the passing of this act, their lands were divided equally among all the male issue, and did not descend to the eldest son alone);—that the laws of England, and no other, shall be used in Wales; besides several other regulations and enactments of inferior moment and interest.

Henry VIII. also passed another statute in the 34th year of his reign, chapter 26, by which the statute already mentioned was confirmed, and further regulations added: by this statute, some peculiar privileges were granted to the Welsh, particularly that there should be courts within the principality itself, independent of the process of Westminster Hall. But this statute claims our attention, at present, in a more direct and especial manner, as being that which gave to the counties of Wales, and to the adjoining counties of England, the names and extent which they still retain. By this act the marches, or intermediate lands between England and Wales, were divided into new counties, or annexed to old counties. The new counties that were now formed, were Monmouth, which was declared an English county, Brecknockshire, Denbighshire, Montgomeryshire, and Radnorshire in Wales. The English counties which were augmented by annexation, were Gloucestershire, Herefordshire, and Shropshire. The Welsh counties which were augmented, were Cardiganshire, Caernarthsire, Glamorganshire, Merionethshire, and Pembrokeshire.

The next inferior division of the territory of England is into trethings, trithings, or tridings; lathes, and rapes. Trething, trithing, or triding, is an appellation evidently derived from the circumstance that the county to which it is applied, is divided into three parts; this appellation is now corrupted into riding, and occurs only in Yorkshire. The terms lathes and rapes are not of such evident and certain etymology or meaning; though there can be no doubt, that though not exactly synonymous with trethings, or the third part of a county, they signify a larger division of it than hundreds. Kent is the only county which is divided into lathes; and Sussex the only one that is divided into rapes. It does not appear that any appropriate officer under the sheriff was appointed to either of these divisions: the trithings, however, were anciently governed by a trithing-reeve. A large division, something similar to trithings, rapes, or lathes, exists in the county of Lincoln: this county is divided into three districts, each of which, like the large divisions of Yorkshire, Kent, and Sussex, contains several hundreds. Perhaps, also, the shires, which are found in some of the northern counties, though now merely nominal, were originally larger divisions of a similar nature; such as Hallamshire, which comprehends the

Statistics.

Wales annexed, 10

Edward I.
Division into hundreds in the time of Alfred.

The next inferior division is that of hundreds. The institution of this division seems rather to have been introduced into England than invented in it; and there is reason to believe, that the Saxons, in the southern part of the island, first introduced it, though this institution, like all the rest, which related to the due administration of justice, has generally been ascribed to Alfred.

It is uncertain, whether the appellation of hundreds was given to these divisions, because they contained a hundred persons; a hundred heads of families; or, as some suppose, a hundred farms; it is, however, most probable, that each hundred contained one hundred heads of families, of freemen. That the hundreds were regulated by population, is evident from the great number of hundreds in those counties that were first peopled by the Saxons, or which, from their local situation, were least exposed to the devastation of war, or from their natural fertility, were most likely to attract, and most capable of supporting a great number of inhabitants; while, on the contrary, those counties, which were gained by the Saxons at a later period, which were held by them on a precarious tenure, and continually liable to invasion, or which were naturally barren and indigent, contained comparatively very few hundreds. Thus, in Kent and Sussex, according to Domesday Book, there were at the period, when that survey took place, respectively 62, and 64 hundreds, the same number which they contain at present; Norfolk, though in size only about the fifth county in the kingdom, contains 660 parishes; a greater number than any other county; and 33 hundreds. Suffolk contains 575 parishes; and Essex 415 parishes; whereas in Lancashire there are only six hundreds; in Cheshire seven; in Cornwall nine; in Northumberland seven divisions, which correspond to hundreds; and in Cumberland five. In some counties there are hundreds that do not exceed a square mile in area, nor contain more than 1000 persons; the hundreds of Lancashire, on the contrary, average 500 square miles; and the population in one of them, Salford hundred, is above 250,000.

In order to remedy the inconvenience resulting from this circumstance, in the reign of Henry VIII., the small hundreds were united, to form divisions, limits, or circuits, while the larger hundreds were partitioned into smaller portions. In the northern parts of England, the counties were not divided into hundreds, but into wards and wapentakes: the former still being the divisions of Cumberland, Westmorland, Northumberland, and Durham; and the latter of Yorkshire. Wards were so called, from the inhabitants of each division being, in ancient times, obliged to keep watch or ward, against the interruptions of the Scots or Picts. The term wapentake is evidently synonymous with weapon-take, and was given to the divisions of Yorkshire from the same circumstance.

The subdivision of hundreds into tithings is undoubtedly owing to Alfred. In ancient times, it was ordained, for the more sure keeping of the peace, that all free-born men should cast themselves into several companies, by ten in each company; and that every one of these ten men should be surety and pledge for the forthcoming of his fellows: for which cause, these companies in some places were called tithings; and as ten times ten make a hundred, so, because it was also appointed that ten of these tithings should, at certain times, meet together for matters of greater weight; therefore that general assembly was called a hundred.

One of the principal inhabitants of the tithing, who was called the tithing-man, or head-borough, and in some counties the borsholder, or boroughs-calder, was annually appointed to preside over the rest, and to take care of their interests. Tithings are seldom mentioned now, except in legal proceedings, or in topographical descriptions.

In Lincolnshire another species of division exists, called Sokes. Sokes, sok, soc, or soka, according to Bracton, signifies the power of administering justice, and the territory or precinct in which the chief lord did exercise his soke, his liberty of keeping court, or holding trials within his own soke or jurisdiction.

Although parishes were originally ecclesiastical divisions, yet now they may be properly considered as coming under the class of civil divisions; and, consequently, claim our attention under that head. It is not easy to determine how ancient the division of England into parishes is: they are mentioned so early as in the laws of King Edgar, about the year 970; but from what occurs relating to them in these laws, it is plain that they were gradually formed. They were originally of the same extent as manors, since it very seldom happens that a manor extends itself over more parishes than one, though there are often many parishes in one manor.

The parochial division of England was nearly the same in Edward First's time, 1288-1292, as it is at present.

Parishes are frequently intermixed with one another. This seems to have arisen from the lord of the manor having had a parcel of land detached from the main part of his estate, but not sufficient to form a parish of itself. It was natural for him to endow the church which he had erected on his principal estate with the tithes of these disjointed lands; especially if it happened, that no church was then built in any lordship adjoinging to these lands.

The setting of the bounds of parishes depends on immemorial custom; though it is probable, that they were not settled with very exact and minute precision till the passing of the poor laws, when, in consequence of the claims of relief from their particular parishes, which these laws gave to the poor, it became a matter of serious consequence to define exactly the limits of each parish. They cannot now be altered, but by legislative enactment.

As it was found, that in the northern counties, where the parishes extended thirty or forty square miles, the poor laws could not be duly administered, a law was passed in the 13th of Charles II. permitting townships and villages, though not entire parishes, to maintain their own poor. Hence townships, in the north of England, may be regarded as divisions subordinate to parishes, and are as distinctly limited as if they were separate parishes.

Towns originally contained but one parish; but many of them now, from the increase of inhabitants, are divided into several parishes. Besides parishes, or townships, there are places which Extra-parochial, or not within the limits of chal places.
any parish. They were formerly the site of religious
houses, or of castles, the owners of which would not
permit any interference with their rights or privileges.
At present, they enjoy a virtual exemption from main-
taining the poor, because there is no overseer on whom
the order of a magistrate may be served—from the
militia laws, because there is no constable to make the
return—and from repairing the highways, because there
is no surveyor. Their tithes are, by inmemorial cus-
tom, payable to the king instead of the bishop. Extra-
parochial wastes and marsh lands, when improved and
drained, are to be assessed to all parochial rates in the
parish next adjoining. In some counties, liberties in-
terrupt the general course of law, as affecting hun-
dreds, in the same manner as extra-parochial places do
with regard to parishes. The number of parishes and
parochial chapellies in England and Wales, is 10,674,
of which about 550 extend into two counties, or into
more than one hundred.

Under the general name of town, are comprehend-
ed the several species of cities, boroughs, and common
towns. A city is a town incorporated, which either is,
or has been, the see of a bishop; for though the bi-
shopric be dissolved, as at Westminster, it still remains
a city. Every town, whether corporate or not, that
sends burgesses to parliament, is a borough. There
are other towns which are neither cities nor boroughs;
some have the privilege of markets, and others not.
To several of these there are attached small appendages,
called hamlets, which originally, according to Sir Hen-
ry Spelman, consisted of less than five freemen. Ham-
lets are sometimes under the same administration as
the town to which they are attached, and sometimes
governed by separate officers.

The number of counties into which England is at
present divided, is forty; and Wales consists of twelve.
Of the former, six may be considered as northern; four
border on Wales; twelve compose the midland district
of England; eight may be classed as eastern; three as
south-eastern; four as southern; and three lie in the
south-west of the kingdom. Wales is divided into two
parts, North Wales and South Wales; in the former
are six counties, and in the latter the same number.

Although, under each of the counties of England and
Wales, a particular description and account of them
will be found, yet it may be proper here, in order to
render this article more complete, to give their bound-
daries, their divisions into hundreds, parishes, &c. and a
list of their principal towns; referring the reader to
each county for further particulars.

The northern division of England consists of North-
umberland, which is bounded by Scotland and Cumber-
land on the west; by Durham and Cumberland on
the south; by the German Ocean on the east, and by
Scotland on the north. It contains one county town,
seven wards, twelve market-towns, and 450 parishes
and townships; the principal towns in it are New-
castle, North Shields, Hexham, Morpeth, and Aln-
wick. Cumberland is bounded by Scotland on the north;
by the Irish Sea on the west; on the east by Northumberland and Durham; and on the south by
Westmoreland and Lancashire. It contains one city,
five wards, 17 market towns, and 99 parishes; the prin-
cipal towns are Carlisle, Whitehaven, Workington, and
Penrith. Durham is bounded on the east, by the Ger-
man Ocean; on the north, by Northumberland; on
the west, by Cumberland; and on the south, by York-
shire. It contains one city, four wards, three detach-
ed hundreds in Northumberland; 14 market towns,
and 118 parishes; its principal towns are Durham,
Sunderland, and Darlington. Yorkshire is bounded
on the north, by Durham and Westmorland; on
the east, by the German Ocean; on the west, by West-
moreland and Lancashire; and on the south, by Cheshire,
Derbyshire, Nottinghamshire, and Lincolnshire. It
contains one city, 30 wapentakes, 60 market towns, and
563 parishes; and is besides, from its great extent, divided
into three ridings, the east, north, and west. In the east
riding, the principal towns are York, Hull, and Beverly;
in the north riding, Whitby, Scarborough, and Rich-
mond; and in the west riding, Leeds, Halifax, Wake-
field, Huddersfield, Sheffield, and Bradford. West-
moreland is bounded, on the north and north-east, by
Cumberland; on the east, by Yorkshire; and on the
south and south-west, by Lancashire. It contains one
county town, six hundreds, 27 market towns, and
61 parishes; its principal towns are Liverpool, Man-
chester, Bolton, Preston, Lancaster, Wigan, Wirral-
ington, Blackburn, Rochdale, and Bury.

The four counties which border on Wales, are Che-
shire, Shropshire, Herefordshire, and Monmouthshire.
The county of Chester is bounded on the north by
Lancashire, and a small point of Yorkshire; on the
east, by Derbyshire and Staffordshire; on the south,
by Shropshire, and a detached part of Flintshire; and
on the west, by Denbighshire and Flintshire. It
contains one city, seven hundreds, 13 market towns, and
68 parishes; the principal towns in Cheshire, are Che-
er, Stockport, Knutsford, Macclesfield, and Nantwich.
Shropshire, or the county of Salop, is bounded by
Cheshire, the detached part of Flintshire, and northern
of Denbighshire, on the north; on the west, by Den-
bighshire, Montgomeryshire, and Radnorshire; on the
south, by Herefordshire and Worcestershire; and on the
east, by Staffordshire. It contains one county town,
14 hundreds, 17 market towns, and 170 parishes;
the principal towns in Shropshire, are Shrewsbury,
Ludlow, Bridgnorth, and Oswestry. Herefordshire is
bounded, on the north, by Shropshire; on the west,
by Radnorshire and Brecknockshire; on the south, by
Monmouthshire and Gloucestershire; and on the east,
by Worcestershire. It contains one city, eleven hun-
dreds, seven market towns, and 176 parishes; its prin-
cipal towns are Hereford, and Ledgister. Mon-
mouthshire is bounded, on the north, by Hereford-
shire and Brecknockshire; on the west, by Glamor-
ganshire and Brecknockshire; on the south, by the
Bristol Channel; and on the east, by Gloucestershire.
It contains one county town, six hundreds, seven mar-
ket towns, and 127 parishes; the principal towns in
Monmouthshire, are Monmouth, Chepstow, and Aber-
gaveny.

The twelve midland counties of England, are Not-
tinghamshire, Derbyshire, Staffordshire, Leicester-
shire, Rutlandshire, Northamptonshire, Warwickshire,
Worcestershire, Gloucestershire, Oxfordshire, Bucking-
hamshire, and Bedfordshire.

Nottinghamshire is bounded, on the north, by
Yorkshire and Lincolnshire; on the east, by Lincoln-
shire; on the west, by Derbyshire; and on the south,
by Leicestershire. It contains one county town, six,
hundreds, nine market towns, and 168 parishes; the principal towns in this county are Nottingham, Newark, and Mansfield. Derbyshire is bounded, on the north, by a small part of Cheshire and Yorkshire; on the east, by Nottinghamshire; on the south, by Leicestershire, a point of Warwickshire, and Staffordshire; and on the west, by Cheshire and Staffordshire. It contains one county town, six hundreds, 11 market towns, and 106 parishes. Its principal towns are Derby, Chesterfield, Buxton, and Matlock. The county of Stafford is bounded on the west by Cheshire and Shropshire; on the east, by Derbyshire and Warwickshire; on the south, by Worcestershire; and on the north, by Cheshire and Derbyshire. It contains one city, one county town, five hundreds, 19 market towns, and 150 parishes. The principal towns in Staffordshire are Lichfield, Stafford, Newcastle under Lyme, and Burton upon Trent. Leicestershire is bounded on the west by Derbyshire and Warwickshire; on the east, by Rutlandshire and Lincolnshire; on the north, by Nottinghamshire and Derbyshire; and on the south, by Northamptonshire. It contains one county town, six hundreds, eleven market towns, and 192 parishes. Its principal towns are Leicester, Longborough, Hinckley, and Lutterworth. Rutlandshire is bounded by Lincolnshire on the north and north-east; by Northamptonshire on the south and south-east; and by Leicestershire on the west. It contains one county town, five hundreds, two market towns, and 55 parishes. The principal towns in this county are Rutland, Oakham, and Uppingham. Northamptonshire is bounded on the north and north-west by Rutlandshire, Lincolnshire, and Leicestershire; on the west, by Warwickshire, Northamptonshire, and Oxfordshire; and on the east, by Bedfordshire and Huntingdonshire; on the south, by Bedfordshire and Huntingdonshire, and a small point of Cambridgeshire. It contains one city, one county town, twenty hundreds, twelve market towns, and 302 parishes. The principal towns in Northamptonshire, are Northampton, Peterborough, Wellingborough, Kettering, and Daventry. Warwickshire is bounded on the south by Oxfordshire and Gloucestershire; on the west, by Worcestershire; on the north-west, by Staffordshire; on the north, by Derbyshire; on the north-east, by Leicestershire; and on the east, by Northamptonshire. It contains one city, one county town, five hundreds, fourteen market towns, and 158 parishes. Its principal towns are Warwick, Coventry, Binningham, and Stratford on Avon. Worcestershire is bounded on the north by Salop and Staffordshire; on the west, by Herefordshire; on the south, by Gloucestershire; and on the east, by Warwickshire. It contains one city, five hundreds, eleven market towns, and 159 parishes. The principal towns in this county are Worcester, Kidderminster, Stourbridge, and Dudley. Gloucestershire is bounded on the south by Wiltshire, and part of Somersetshire; on the north, by Worcestershire; on the west, by Monmouthshire and Herefordshire; and on the east, by Warwickshire and Oxfordshire. It contains two cities, one county town, 23 hundreds, 26 market towns, and 280 parishes. Its principal towns are Gloucester, Bristol (in part), Cirencester, and Tewksbury. Oxfordshire is bounded on the north by Northamptonshire and Warwickshire; on the west, by Gloucestershire; on the south, by Berkshire; and on the east, by Buckinghamshire. It contains one city, 14 hundreds, 12 market towns, and 280 parishes. The principal towns in this county are Oxford, Witney, Woodstock, and Banbury. Buckinghamshire is bounded on the north by Northamptonshire; by Berkshire, and a point of Surrey, on the south; by Middlesex, Hertfordshire, and Bedfordshire, on the east; and by Oxfordshire on the west. It contains one county town, eight hundreds, 16 market towns, and 185 parishes. Its principal towns are Buckingham, Aylesbury, and Eton. Bedfordshire, the last of the midland counties, is bounded on the north by Huntingdonshire and Northamptonshire; on the west, by Buckinghamshire; on the south, by the same county and Hertfordshire; and on the east, by Cambridgeshire and Hertfordshire. It contains one county town, nine hundreds, ten market towns, and 124 parishes. The principal towns in this county are Bedford, Dunstable, and Ampthill. The eight eastern counties the, Linconshire, Huntingdonshire, Cambridge, Bedford, Farnsfolk, Essex, and Hertfordshire, and Middlesex. The county of Lincoln is bounded on the north by Yorkshire; on the east by the German Ocean, and by a part of Norfolk; on the west by Nottinghamshire and Leicestershire; and, on the south, by the counties of Rutland, Northamptonshire, and Cambridgeshire: it contains one city, 31 hundreds, 31 market-towns, and 630 parishes. The principal towns in Lincolnshire are, Lincoln, Boston, Stamford, and Gainsborough. Huntingdonshire is bounded on the south and south-east by Cambridge, on the north-east by the same county; on the north and north-west by Northamptonshire; and on the south-west by Bedfordshire. It contains one county town, six market-towns, four hundreds, and 107 parishes. Its principal towns are, Huntingdon and St Ives. Cambridgeshire is bounded on the west by Bedfordshire, Huntingdonshire, and a point of Northamptonshire; on the south by Suffolk, Essex, and Hertfordshire; on the north-west by Lincolnshire; and on the north-east by Norfolk. It contains one city, one county town, 15 hundreds, eight market-towns, and 163 parishes. The principal towns in Cambridgeshire are, Cambridge, Ely, Wisbeach, and Newmarket. Norfolk is bounded on the north and north-east by the German Ocean; on the south and south-east by Suffolk; and on the west by Lincolnshire and Cambridgeshire. It contains one city, 33 hundreds, 32 market-towns, and 660 parishes. Its principal towns are, Norwich, Yarmouth, and Lyn. Suffolk is bounded on the west by Cambridgeshire; on the east by the German Ocean; on the south by Essex; and on the north by Norfolk. It contains one county town, 22 hundreds, 29 market-towns, and 575 parishes. The principal towns in this county are, Ipswich, Bury St Edmunds, and Lowestoft. The county of Essex is bounded on the north by Suffolk and a part of Cambridgeshire; on the south by the Thames, which divides it from Kent; on the east by the German Ocean; and on the west by Hertfordshire and Middlesex. It contains one county town, 14 hundreds, five half-hundreds, one royal liberty, 27 market-towns, and 415 parishes. The principal towns in Essex are, Chelmsford, Harwich, Colchester, Bocking, and Braintree. Hertfordshire is bounded on the south by Middlesex; on the north by Cambridgeshire and Bedfordshire; on the west by Bedfordshire and Buckinghamshire; and on the east by Essex. It contains one county town, eight hundreds, 19 market-towns, and 120 parishes. Its principal towns are, Hertford, St Albans, Ware, and Barnet. Middlesex is bounded on the east by Essex; on the west by Buckinghamshire; on the north by Hertfordshire; and on the south by Surrey and a corner of Kent. It contains two cities, six mar-
The three south-eastern counties of England are, Surrey, Kent, and Sussex. Surrey is bounded on the north by Middlesex and a point of Buckinghamshire; on the south by Sussex; on the east by Kent; and on the west by Berkshire and Hampshire. It contains one county-town, 13 hundreds, 14 market-towns, and 140 parishes. The principal towns in Surrey are, Southwark, Guildford, Kingston-on-Thames, Fareham, Dorking, and Croydon. The county of Kent is bounded on the north by the Thames; on the east and south-east by the German Ocean and the Straits of Dover; on the south by Sussex; and on the west by Surrey. It contains two cities, one county-town, five lathes, 62 hundreds, 59 market-towns, and 408 parishes. Its principal towns are, Canterbury, Rochester, Maidstone, Chatham, Gravesend, Dover, and Tunbridge. Sussex is bounded on the north by Surrey and Kent; on the west by Hampshire; on the east by Kent, and the British Channel; and on the south by the latter. It contains one city, six rapes, 18 market-towns, 65 hundreds, and 32 parishes. Its principal towns are, Chichester, Lewes, Hastings, and Horsham.

The four southern counties of England are, Berkshire, Wilts, Hampshire, and Dorsetshire. Berkshire is bounded by Oxfordshire and Buckinghamshire, on the north; on the north-west by a point of Gloucestershire; on the south by Hampshire; on the east by Wiltshire; and on the west by Wiltshire. It contains one county-town, 20 hundreds, 12 market-towns, and 147 parishes. Its principal towns are, Reading, Abingdon, Windsor, and Newbury. Wilts is bounded on the north by Gloucestershire; on the east by Berkshire and Hampshire; on the south by Dorsetshire; and on the west by Somersetshire and Gloucestershire. It contains one city, 29 hundreds, 23 market-towns, and 304 parishes. Its principal towns are, Salisbury, Devizes, Wilton, Bradford, Trowbridge, and Chippenham. Hampshire, which includes the isle of Wight, is bounded on the north by Berkshire; on the east by Surrey and Sussex; and on the west by Wiltshire and Dorsetshire; and on the south by the English Channel. It contains one city, two county-towns, 38 hundreds, 20 market-towns, and 253 parishes. The principal towns in this county are, Winchester, Southampton, and Portsmouth; and Newport, Cowes, and Yarmouth, in the isle of Wight. Dorsetshire is bounded on the south by the English Channel; on the north by Wiltshire and Somersetshire; on the west by Devonshire; and on the east by Hampshire. It contains one county-town, 94 hundreds, 24 market-towns, and 248 parishes. The principal towns in this county are, Dorchester, Poole, Weymouth, Bridport, Blandford, and Shaftesbury.

The three counties in the south-western part of England are, Somersetshire, Devonshire, and Cornwall. Somersetshire is bounded on the north-west by the Bristol Channel; on the north-east by Gloucestershire; on the east by Wiltshire; and on the south by Dorsetshire and Devonshire. It contains two cities, and part of a third (Bristol), 43 hundreds, 32 market-towns, and 385 parishes. Its principal towns are, Bath, Wells, Taunton, and Bridgewater. Devonshire is bounded by the Bristol Channel on the north and north-west; by the English Channel on the south and south-east; by Cornwall on the west; and by Dorsetshire and Somersetshire on the east. It contains one city, 33 hundreds, 39 market-towns, and 394 parishes. The principal towns in Devonshire are, Exeter, Plymouth, Barnstaple, and Honiton.

North Wales comprises six counties; Flintshire, Caernarvonshire, Anglesey, Merionethshire, and Montgomeryshire. Flintshire is bounded by the Irish Sea on the north; by the estuary of the Dee and the county of Cheshire on the north-east and the east; and by Denbighshire on the south and west. It contains one county-town, nine hundreds, 27 market-towns, and 198 parishes. Its principal towns are, Bangor, Holyhead, and Caernarvon. Caernarvonshire has the sea on all sides of it, except the east, where it is bounded by Denbighshire; and the south, where it is contiguous to Merionethshire. It contains one county-town, ten hundreds, five market-towns, and 71 parishes. Its principal towns are Bangor and Caernarvon. The county of Anglesey is divided into seven, and comprises one county-town, six hundreds, six market-towns, and 36 parishes. Its principal towns are, Bangor, Caernarvon, and Holyhead.

The six counties in South Wales are, Radnorshire, Cardiganshire, Pembrokeshire, Caermarthenshire, Brecknockshire, and Glamorganshire. Radnorshire is bounded on the north by Montgomeryshire; on the east by Brecknockshire and Monmouthshire; on the south-east by Brecknockshire; and on the north-west by Cardiganshire. It contains one county-town, six hundreds, four market-towns, and 47 parishes. Its principal towns in this county are, Radnor, Presteigne, and New Radnor.

Cardiganshire is bounded from the north-east to the south-west by the Bay of Cardigan; on the north by a point of Merionethshire; on the east by Radnorshire and Brecknockshire; and on the south by Cardiganshire and Pembrokeshire. It contains one county-town, five hundreds, four market-towns, and 77 parishes. Its principal towns are Cardigan and Aberystwyth.
ENGLAND.

Cardiganshire; and on its eastern side, where it joins Caermarthenshire, it contains one city, one countytown, seven hundreds, nine market-towns, and 45 parishes. Its principal towns are, Pembroke, St David's, Tenby, and Haverford West.—Caermarthenshire is bounded on the north by Cardiganshire; on the east by Brecknockshire; on the west by Pembroke and on the south by Glamorgan and the sea. It contains one county-town, eight hundreds, six market-towns, and 87 parishes. The only town of consequence in this county is Caermathen.—Brecknockshire is bounded on the south-east, and partly on the south, by Monmouthshire; on the rest of the south by Glamorgan; on the west by Caermarthenshire and Cardiganshire; on the east by a small part of Herefordshire; and on the north-east by Radnorshire. It contains one county-town, six hundreds, four market-towns, and 59 parishes. Its principal towns are Brecon and Crickhowell.—Glamorgan is bounded on the south and west by the Bristol Channel; on the north by Caermarthenshire and Brecknockshire; and on the east by Monmouthshire. It contains one city, one county-town, 10 hundreds, eight market-towns, and 118 parishes. The principal towns in this county are, Caerphilly, Mold, Swansea, and Myrtwy-Tedwi.

Three of the counties in England are called counties Palatine, viz. Cheshire, Durham, and Lancashire: they are so called a palatia, because formerly the owners of them had the same rights, powers, and privileges, within them respectively, as the King himself possessed in his palace. These privileges appear to have been granted to the counties of Chester and Durham, because they bordered on an enemy's country; and for the same reason, Pembroke and Hexhamshire, (the latter of which is now united to Northumberland,) were formerly counties palatine. Of those which yet remain so, Durham is the only one now in the possession of a subject; the earldom of Chester was united to the crown by Henry III. and has ever since that period given a title to the eldest son of the king; and by various acts of parliament, the inheritance to the whole lands of the Duchy of Lancaster is vested in the crown. The Isle of Ely, though not strictly speaking a county palatine, possesses the same right as a royal franchise; the bishop of Ely, by a grant of Henry I. exercising, within the isle, a jurisdiction over all causes, as well criminal as civil.

Counties corporate, are certain cities and towns, some with more, some with less territory annexed to them; to which has been granted, by the special favour of the kings of England, the privilege to be counties of themselves. They are governed by their own sheriffs, or other magistrates; so that no officers of the county at large have any authority over them. Counties corporate, as well as corporate towns, are not included in any hundred; most of the cities of England, as well as the five towns of Kingston-upon-Hull, Nottingham, Newcastle-upon-Tyne, Poole, and Southampton, are counties corporate.

The town of Berwick-upon-Tweed originally formed part of Scotland; but it was reduced under the possession of the crown of England, by Edward I. by whom a charter, bestowing upon it certain privileges, was granted to it: this charter was confirmed by Edward IV. and James I. It is specially named in all acts of Parliament.

The Isle of Man is a distinct territory from England, and not governed by its laws, nor by any act of Parl-VOL. VIII. PART II.-liament, unless it is particularly named in it. The principal places in this island are Douglas and Castle Town.

The islands of Jersey, Guernsey, Alderney, and Sark, formerly belonged to the Duchy of Normandy; but were united to the crown of England by the first princes of the Norman line. They are bound by their own laws; but an appeal lies from their courts to the king in council. Unless particularly named in acts of Parliament, they do not extend to them. Each of these islands is divided into parishes, which are again subdivided into what are called vintons.

CHAP. II.

Face of the Country.

The most extensive or highly favoured tracts on the face of the globe, can scarcely exhibit a greater variety of features than England displays. In some parts, verdant plains extend as far as the eye can reach, watered by copious streams, and covered by innumerable cattle. In others, the pleasing vicissitudes of gently rising hills and bending vales, fertile in corn, waving with wood, and interspersed with meadows, offer the most delightful landscapes of rural opulence and beauty. Some tracts abound with prospects of the more romantic kind; lofty mountains, craggy rocks, deep narrow dells, and tumbling torrents; nor are there wanting, as a contrast to so many agreeable scenes, the gloomy features of black barren moors, and wide uncultivated heaths." Such is the general description of the face of the country of England, given by a writer who, both from the powers of his pen, and his acquaintance with the country he was describing, was capable of drawing a just and striking picture: but it will be proper and instructive, as well as interesting, to enter into a more detailed description of the physiognomy, as it has been termed, of the country of England. The chief features of any country are its vales, hills, rivers, and lakes; and, of a maritime state, its sea coast. We shall first describe the vales and hills of England, and afterwards attend to its hydrography; under this head comprehending a description of its sea coast, and its rivers and lakes.

In the English language, the words vale, valley, and dale, have very appropriate and distinct meanings:—vale, which corresponds in meaning with the word strath in Scotland, signifies an extent of low country, some miles in width, lying between ranges of higher grounds: the word valley is the diminutive of vale; it is commonly used in the south of England, but in the north of England and in the south of Scotland, the word dale is used in the same acceptation, and in the highlands of Scotland the word glen. In a valley, the lower grounds are narrow, as from half a mile to a mile or two in width, generally with a high steep bank rising on each side. The dell of the south of England corresponds to the groy or gill of the north of England, and the leugh of the south of Scotland is the diminutive of dale or valley, and generally signifies the branch of a valley, or a short or otherwise inferior valley; dingle is the diminutive of dell.

Of these we mean to confine ourselves entirely to a description of the vales of England; the vallies, dells, and dingles, are too numerous; and most of them, though beautiful or striking in their scenery and features, too unimportant to be particularly noticed.
bason formed by eminences on every side, except one narrow outlet for its waters. The rivers which flow through it are the Derwent and Rye. The district of Holderness, though not strictly speaking a vale, has so Holder- decidedly the natural characters of a true vale district, not.

The vale of Pickering, the remaining quarter is filled up with the chalk cliffs of the Wold; its form is an imperfect oval, the larger diameter of which is about 35 miles; its shorter rather more than 10; its area contains nearly 300 square miles. This vale has all the appearance of a lake left dry by nature; it is in fact a

The vale of York may justly be regarded as the first of the Yorkshire dales; it is situated between the Tees and the Wharfe, the marshes of Yorkshire and Lincolnshire constitute its southern boundary; its western limits are the limestone lands of West Yorkshire, and the skirts of the Western moors; the moorlands, limestone heights, and wolds, of the East Riding, constitute its eastern boundary. From north to south its length is about 60 miles; its average breadth is about 10; its area contains more than 1000 square miles. There are nine towns in the area of this vale, the principal of which are York, Helmsley, Thirsk, and Boroughbridge; its western margin is studded with Richmond, Rippon, Knaresborough, Tadcaster, and Doncaster; on its eastern margin there are four towns, none of them however of any size or consequence. The surface of this vale is sufficiently diversified, to give richness and beauty to its appearance; by far the largest portion of its soil is fertile, and its agriculture is generally good. The northern extreme of the vale of York imperceptibly unites with the south-west margin of the vale of Stockton; the rising ground by which they are naturally divided, being so inconsiderable, as to escape the eye in a general view of the country. Thus, there is an uninterrupted continuance of wide spreading vale lands, from the mouth of the Tees to the Humber, a distance of almost a hundred miles.

The limestone lands of east Yorkshire, which stretch westward from near Scarborough, along the feet of the moorlands, to the Hambledon hills, and then bend southward to the extremity of those hills, where the line returns eastward, and along the Howardian hills to Malton, form three-fourths of the outline of the vale of Pickering; the remaining quarter is filled up with the chalk cliffs of the Wold: its form is an imperfect oval, the larger diameter of which is about 35 miles; its shorter rather more than 10; its area contains nearly 300 square miles. This vale has all the appearance of a lake left dry by nature; it is in fact a

There is no vale, or flat tract of land of considerable extent or importance, as we enter England on the west side from Scotland, till we reach Lancashire, if we except the district of Carlisle. This may, with little latitude, be deemed an extensive plain; indeed, for several miles round this city, there is a vale district of the first quality; but the plain, taken in its whole extent, is bounded on the north by the estuary of the River and the moss of the Solway; on the north-east, by the heights of Gillland; on the east, by the moorlands of Cumberland; on the south, it unites with the valley of Appleby; and on the west, by the slate-rock mountains and the inlet of Abbey Holm. Its area is four or five hundred square miles; it is only on its southern margin that in its elevation it rises above the true vale character.

The vale of Woofdale (or Woofdale) is also a vale which enjoys a great degree of fertility, is formed by Warring- the Mersey, and comprises a considerable extent of land, ground, both on the Lancashire and Cheshire side of that river.

Cheshire is in general a flat country; a ridge of high ground crosses it from north to south on its western side; and on its eastern border there are some considerable eminences, which unite with the hills of Derbyshire and Staffordshire: the rest of the county is nearly level.

The vale of Severn, taken in its most comprehensive sense, may be considered as beginning above Chepstow: Severn river receives Worcestershire almost entirely in its outline; it then contracts and closes on the north with the hills of Shropshire and Staffordshire. Its banks on the west, are formed by the forest of Dean, Malvern, and the Malvern hills, and the hills of Herefordshire and Shropshire. Its eastern banks are formed by the lower parts of the river, Warwickshire, closing with the Lye and Clent hills. It is partially divided into three districts, by Brecon hill and some smaller hills, the district of Worcestershire, the vale of Gloucester, and the vale of Evesham; but if we could suppose these hills and some hillocks near Gloucester removed, the whole would form an unbroken vale, which accompanies the Severn from the union of its principal branches till it enters the British Channel. The upper part of this extensive vale is rich, but not picturesque; it is too flat, and the banks in this part are tame. Its more striking and finished
The vale of Gloucester, or that vale which accompanies the Severn through Gloucestershire, and which has already been noticed as part of the vale of the Severn, deserves to be particularly noticed. It may be divided into two districts,—the vale of Gloucester, and the vale of Berkeley. The form of the vale of Gloucester is semicircular, the Severn composing the chord, and the environs of hills the arch: in it lie the city of Gloucester, and the towns of Tewksbury and Cheltenham. Its extent from Matson-hill to Bredon-hill, on the north, is 15 miles; its breadth from the Severn to Dowleshill is seven or eight miles. It contains 100 square miles, or between 50,000 and 60,000 acres.

The vale of Berkeley approaches, in its outlines, nearer to the segment of a circle than to any other regular figure; the river Severn forms an irregular chord; the hills to the south and east, a curve, which is continued to the northern end by the Matson hills; from the foot of these hills to Aynsley, its extent is about 25 miles; its medium width about four miles. It contains about 80 square miles, or 50,000 acres. The waters of the Severn, which here form a lengthened estuary rather than a river, produce infinite grandeur when they mix in the view. The surface, which is somewhat irregular, is clad in perpetual verdure: the bottoms of the hills stretch in many places towards the river, hung with beech of the most luxuriant growth: the soil is uniformly rich, and the scenery, in general, extremely fine. The land is almost entirely appropriated to grass, there being scarcely 1000 acres under the plough in the whole district.

In the south-west of England, the vales of Exeter and Taunton are the most worthy of notice and description. The vale of Exeter accompanies the Exe from the sea to the Tiverton hills, which constitute its northern boundary. This boundary is continued toward the east by Blackdown hill, till it reaches the Honiton hills. The western boundary of the vale is the Halldown hills, and a continuation of some heights that lie to the north of Exeter: here the vale spreads to the west, till it approaches Credington. It contains about 200 square miles, and is watered by the Exe and the Otter.

The vale of Taunton lies in the north-west quarter of Somersetshire. It is bounded on the north by the Quantock hills; on the south, by the Blackdown hills, which separate it from the vale of Exeter; on the west, it is bounded by the skirts of Exmoor; its boundaries on the east are not accurately defined, but in general they are formed by the rising grounds of Curry, and the marsh of South Sedgmore. The vale of Taunton is small, comprising only about 100 square miles; the river Tone runs through it: its productions are corn, particularly wheat, of remarkably fine quality.

The prolific vale of Aylesbury lies in the county of Buckingham. It is formed by the river Thames, and a small stream which falls into that river at the bottom of the vale. It furnishes a rich pasturage to an immense number of cattle, its amazing fertility being principally employed in the support of the dairy and grazing systems.
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tract of land, in general level, though in some places its surface is varied with gentle eminences. It extends from Ashworth in Kent, to Petworth in Sussex; being bounded, for the most part, by the South Downs on the south, and by the chalk hills of Kent and Surrey on the north. In length it is about sixty or seventy miles, and its breadth is from ten to fifteen. It contains nearly 1000 square miles. The soil of the Weald, for the most part, is a pale clay, interspersed occasionally with tracts of heath, especially in the Sussex division of it. The greater part of it is in a tolerably good state of cultivation; and from the tops of the adjacent hills it affords one of the finest views imaginable. Its original appellation seems to have been the Wild Forest, or Chase; and the Saxon Chronicle informs us, that the Britons called it Andrede, the Marvellous, or Coide Andrede, the Mighty Wood. It was, at that period, a rude uncultivated waste, overgrown with wood, for which it is still famous. In order that it might be reclaimed, the Saxons united parcels of it to the farms in the neighbourhood; and it was applied to the purpose of feeding the hogs of the tenants, being deemed unfit either for arable or pasture. The valleys in which it abounds were first brought into a state of cultivation, and took their respective apppellations from the persons who brought them into this state; as Haldean, (or valley,) Tenterden, Maldean. In process of time, and in the Kentish part of the Weald, in consequence of the custom of gavelkind, these deeds are become, by division and subdivision, very small, in comparison of what they originally were. In the winter season, and in wet weather, the roads in many parts of the Weald are scarcely passable. On the principal roads, which are from fifty to sixty miles broad, there are generally paved causeways, about three feet wide, for the accommodation of the foot passengers.

The other level tracts of England that deserve, on account of their extent, to be particularly noticed, are the fens, Romney marsh, and the marshes of Somersetshire, together with some of the principal heaths that lie on level ground. The fens, as they are emphatically termed, lie in the counties of Northampton, Lincoln, Norfolk, Suffolk, Cambridge, Huntingdonshire, and part of the isle of Ely. These fens are frequently mentioned by our ancient civil and ecclesiastical historians. During the period of the power and splendour of the Catholic religion, they were maintained in tolerably good order, under the direction and patronage of the clergy and monks, who had many rich religious houses scattered through them, such as Peterborough, Ely, Croyland, Ramsey, Thorney, &c. After the dissolution of these religious houses, at the Reformation, the estates belonging to them coming into private hands, the dikes and drains which the clergy had caused originally to be erected, and which they had kept in repair, fell into decay, and, in consequence, the country was overflowed, and reduced gradually into a wretched condition. The legislature at length found it absolutely necessary to interpose; and a statute was passed, 43d Elizabeth, chap. ii. for the purpose of draining them. Great objections, however, were made to this plan by some, on account of its supposed impracticability, or on account of the enormous expense which it would require; and by others, on the ground, that, even in the state in which they were, they would pay better than if they were to be drained and embanked, at the expense which would necessarily be required. In consequence of these objections, this plan was not carried into execution at that time. In the reign of James I., two laws were passed in favour of draining these fens; but these also were not carried into effect. At last, in the 13th year of the reign of Charles I., a charter was granted to a corporation, with Francis, Earl of Bedford, at their head, for draining the great level. The civil wars for a time prevented the commencement of the work; and when, in 1653, it was begun, it was again opposed, on the allegation that the fens produced as much in reeds and sedge, as they could be made to do by expensive draining. In answer to this, an account was taken that year, from which it was proved, that the wheat, barley, oats, hemp, flax, &c. which grew on 28,000 acres, yielded L.113,000. After the Restoration, the corporation was legally and permanently settled, by the 15th Charles II. chap. 17; and on the basis of this statute, this important undertaking has rested ever since. By the Bedford Level, as it is called, upward of 500,000 acres of land have been drained; and since the completion of that work, other large tracts in this fenny country have also been reclaimed.

Romney Marsh, in the county of Kent, is an extensive tract of level rich land, lying on the south coast. What is strictly included under this appellation, comprehends about 23,925 acres; but when it is described, as it generally is, in connection with the Wealden Marsh, which adjoins it on the south-west, and with Denge Marsh, which unites with the latter on the south-east, it includes about 43,326 acres. The level tract of land, however, in this part of England, is still more extensive; for Guildford Marsh, which lies to the west of Wealden Marsh, comprises 3263 acres: most of this latter tract is in the county of Sussex. The soil of those sparsely levels is uncommonly rich, being almost entirely a deposit from the sea; it consists of a soft and unctuous clay, mixed with a greater or less proportion of sea sand. In the summer season, when the surface is clothed with luxuriant verdure, and covered with numerous flocks of sheep and droves of cattle, the appearance of these levels is uncommonly beautiful and interesting. They differ from the fens in this respect, that they were not recovered, but wrested from the sea; but at what period is not accurately known. It is probable, however, that parts of these lands were gained during the early part of the Saxon period of our history. Somner, in his discourse concerning Roman ports and forts in Kent, produces a charter of marsh land by Plegmund, who was archbishop of Canterbury, from A.D. 889 to 913; and this charter seems not to have been among the first. The clergy, indeed, in this part of the kingdom, had a great interest in regaining these lands, as most of the property in the vicinity of them belonged to them; and the practice of innining, as it was called, that is, wresting land from the sea, is commonly supposed to have originated with them. The archbishop of Canterbury, in particular, applied themselves to this object, and gave their names to the land which they respectively gained. Thus we read of Becket's, Baldwin's, Boniface's, Peckham's innings. The whole level is prevented from being overflowed at high water, by an immense embankment, called Dymchurch Wall, from its contiguity to the village of that name. This wall forms the only highway for carriages, along its whole extent, between Hith and Romney. Its perpendicular height from the marshes is, in most parts, from twelve to eighteen or twenty feet. The slopes are steep, and pretty regular. Next the sea, it forms a shelving irregular beach, that is carried out to the distance of more than 100 yards. The width of the top of the wall is

\[\text{Statistics.}\]

\begin{align*}
\text{Weals of Kent, &c.} & \\
\text{Statistical.} & \\
\text{Number of acres.} & \\
\text{Number of people.} & \\
\text{Number of farms.} & \\
\text{Number of cottages.} & \\
\text{Number of suitors.} & \\
\text{Number of tithes.} & \\
\text{Number of parishes.} & \\
\text{Number of churches.} & \\
\text{Number of schools.} & \\
\text{Number of hospitals.} & \\
\text{Number of prisons.} & \\
\text{Number of poorhouses.} & \\
\text{Number of poor.} & \\
\end{align*}
from fifteen to nearly thirty feet. Its length is rather more than three miles. Arched sluices, that pass under the banks; each with two pair of flood-gates, effect the drainage. When the tide is low, the waters are allowed to pass off by means of these gates, while they prevent the sea from entering when the tide is full. By ancient custom, the lords of the twenty-three manors in and adjoining to the marsh, have the management and superintendence of the drainage. They appoint a bailiff, as principal supervisor of the works. Edward III. granted a charter of incorporation for the same purpose. By this charter, the laws respecting Romney marsh are to be administered by a bailiff, twenty-four jurats, and the commonalty; who are empowered to hold a court every three weeks, to decide on all pleas, and to choose four judges from among themselves yearly, besides the bailiff, whose authority is to be similar. The bailiff, chosen by the lords of the manors interested in the marsh, is generally the same person, as the bailiff chosen under the charter of Edward III. The courts are held at Newhall, in Dymchurch; and the scots, or levies, for the preservation of the embankment, are then paid.

We have dwelt thus long and minutely on the fens of Lincolnshire, &c. and the marshes of Kent, &c. because they present very interesting and extensive tracts of level land, and therefore form a prominent feature in the physiognomy of the kingdom, and because their improvement is a matter of great national concern and benefit. But we must pass over the marshes of Somersetshire, and the level heaths of the kingdom, with less particular and extended description. Selgro. 

Selgro is the largest and most remarkable district of marsh and level land in the county of Somerset; besides it, there are the Brent marshes, and the low watery grounds, that stretch themselves to a great extent on that side of the county. If to these we add the Connington fens, and the mirey tracts in their vicinity, we shall comprehend nearly the whole extent of marsh land in Somersetshire.

The most extensive level heaths in the kingdom, are those of Bagshot, and those which lie on the confines of Dorsetshire and Hampshire. Bagshot heath forms the north-western corner of the county of Surrey, and presents a very large tract of uncommonly barren land, for the most part quite level and uninteresting. The heaths of Hampshire and Dorsetshire are much less level, and perhaps not quite so irremovable. They commence about half way between Christchurch, in the former county, and Poole, in the latter.

Such are the principal vales and level tracts of England and Wales; and from this account and description of them, it will be seen, that the most extensive and uninterrupted level tracts are on the eastern side of the kingdom; while, with the exception of the vale of York, the most extensive, as well as the most beautiful, vales are on the western side, between England and Wales.

The next grand and distinguishing feature in the physiognomy of the country, consists of the mountains, hills, and moorlands; under the last denomination, comprehending the principal elevated tracts of heathy or moorish ground.

Through the whole length of England and Wales, there are groups of mountains and hills, which, when viewed on a grand scale, may be considered as forming one chain, extending along the western side of the kingdom, from Cornwall to Cumberland. In this chain, all the highest mountains of England and Wales are situated. The breadth of the kingdom may also be considered as determined by two lower ranges of hills; one of which extends from Dorsetshire into Kent, while the other stretches, in a waving line, from the island of Portland to the Wolds, in the east riding of Yorkshire. The line which is formed by this latter chain of hills, passes on the western side of Wiltshire and Oxfordshire, and through Northamptonshire, Leicestershire, Nottinghamshire, nearly to Scarborough. The Bristol Channel, and the low grounds of Lancashire and Cheshire, break and divide the western chain of mountains into three parts; which have been denominated the Northern, the Cambrian, and the Devonian range.

The northern range enters Cumberland from Scotland, and, passing through that county and Westmoreland, extends its branches into Northumberland and Durham. The branch which enters Northumberland composes the Cheviot Hills. It is not easy to form an estimate of the extent of these hills, as they unite with the morland district of Northumberland to the south, and are continued to the westward by similar green hills in Scotland. On the supposition that their bases occupy a circle of about fifteen miles in diameter, their contents will be from 150 to 200 square miles. In form, many of them are conical, some of them nearly perfect cones, while the shape of others is very irregular; in general, however, they are pointed, their sides are steep and smooth, and their bases are nearly in contact one with another. The soil on these mountains, except at their very tops, where points of rock and loose stones appear, is fertile; from base to summit, they present a refreshing and rich green sward. On the upper parts of that hill, which is emphatically denominated the Cheviot, however, extensive heaths are found.

That chain of northern mountains which may properly be called the Cumberland chain, commences at Geltisdale Forest, fourteen miles south-east of Carlisle, and passes on the west of Durham and Yorkshire. The surface of these mountains, in general, is excessively ragged; and in their disposition there is nothing of regularity, no lengthened ridge or continuous chain. The appearance of the whole is that of a congeries of broken and mostly pointed masses; their bulk immense, and their bases united, or nearly so, except in those places where they are divided by the lakes which are scattered among them. The Cumbrian hills resemble the Cheviot in the green sward with which they are covered; but Skiddaw, like Cheviot, is partially clothed with heath. The extent of this tract of mountains in Cumberland, Westmoreland, and Lancashire, is about 500 or 600 square miles.

The northern range, taking it in its utmost extent, forms, by its mountains and vallies, the fascinating scenery round the lakes of Cumberland and Westmoreland—the gloomy grandeur of Craven, in Yorkshire—and the romantic dales of Derbyshire. The loveliest part of it is seen in all its magnificence on the road from Kirby Lonsdale to Kendal. The general height of these mountains is from 3000 to 3400 feet. According to the barometrical admeasurements of Mr Dalton, the particular heights of the most remarkable are as follows:

<table>
<thead>
<tr>
<th>Mountain</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Fell</td>
<td>3240 ft</td>
</tr>
<tr>
<td>Helvellyn</td>
<td>3225 ft</td>
</tr>
<tr>
<td>Skiddaw</td>
<td>3175 ft</td>
</tr>
<tr>
<td>Grassmere</td>
<td>2865 ft</td>
</tr>
<tr>
<td>Hill Bell</td>
<td>2436 ft</td>
</tr>
<tr>
<td>Coniston Oldman</td>
<td>2371 ft</td>
</tr>
</tbody>
</table>
England.

Ingleborough is nearly the same height as Whernside. Crossfell, in Cumberland, which borders on the county of Durham, according to Donaldson, is 3590 feet; and according to Mr Bailey, (in his Agricultural Report of Cumberland,) 3400 feet. The height of Saddleback, according to the latter author, is 3048 feet.

The southern division of the northern range, is divided from the northern division, by the valley of the Ribble, Craven, and the valley of the Ayre: its western boundary is formed by the lower, or vale lands of Lancashire and Cheshire; its eastern, by the manufacturing districts of Yorkshire; and its southern, by the upper grounds of Derbyshire and Staffordshire; the extent of these hills is above 60 miles: their width is extremely irregular, being upwards of 20 miles from the feet of the Cheshire hills, to the hills near Sheffield, whereas between Blackstone-edge and Huddersfield, they merely form a ridge. The highest hills in Derbyshire are Kinder Scout, near Hayfield; Edge near Buxton, and Whinbill and Mam Tor near Castleton; but they are much lower than the mountains of Cumberland, the highest part of Derbyshire not being more than 2100 feet above the sea.

As we approach the Alpine districts on the west of England, we meet with some hills, which it may be proper to notice, before we proceed to the consideration of the Cambrian range. The Malvern hills, which are situated partly in Gloucestershire, but principally in Herefordshire and Worcestershire, are from 1100 to 1300 feet high: the highest parts are those distinguished by the names of Herefordshire and Worcestershire beacons; the former rising near 1250, and the latter 1300 feet above the level of the plain; the Malvern hills extend for ten miles, rising on the eastern side, from the flat country, which forms the vale of the Severn; they are connected on the western side with a range of lower hills, which extend several miles into Herefordshire.

The Cotswold and Stroudwater hills, in Gloucestershire, are by some regarded as a continuation of the central chain, proceeding south from Derbyshire, and passing through Gloucestershire into Wiltshire, thence swelling into the Salisbury downs, and afterwards running west towards the Land's End in Cornwall. If viewed in this light, they may be regarded as connecting the northern with the Devonian range. The extent of the Cotswold hills, from Broadway hill to near Tetbury, is 30 miles; their area, about 200,000 acres; their surface is billowy; and their climate, if the natural elevation of the land is considered, unusually mild. The sides of the hills abound with springs, "and almost every dip has its rill, and every valley its brook." The Stroudwater hills partake, in some parts, of the character and features of the Cotswold hills, and in other parts, they partake of the vale character.

The Wrekin.

The Wrekin hill in Shropshire is so much higher than the surrounding hills, that it appears to rise alone from the middle of the plain. It is craggy at the top, its form is that of a long oval, pointing nearly north and south; it has been supposed very exactly to resemble a whale asleep on the surface of the sea. The most precipitous side of this mountain, is the eastern; its height is reckoned about 1200 feet. The Wrekin may be considered as the northern extremity of a ridge, lying in the same line with it, and consisting of the hills of Frodsham, Caradoc, &c; each of these, has the long diameter from north to south. They are craggy at the top, and ascend from the plain of Salop very abruptly, at an angle of about 60°.

The Cambrian range of mountains is considerably more elevated in North than in South Wales, extending through Caernarvonshire and Merionethshire, and declining in height as they pass through Cardiganshire. The direction of this range in Caernarvonshire is north-eastern, from Bardsey Island to a promontory in the bay of Conway. The mountains composing it are the highest of any in Wales, and gradually ascend from each extremity of the range towards the centre, which is formed and occupied by Snowdon, the loftiest of all; the altitude of the highest point of this celebrated mountain is about 3600 feet from the high-water mark on Caernarvon quay. It is composed of various cliffs, rising one above another; and that particular peak, to which the name of Snowdon is given, scarcely exceeds in height several of the summits that surround it on all sides.

From Snowdon, a line of mountains extends by the sea to Plynlimmon, a boundary of North Wales; of these mountains, the most lofty and the most celebrated is Cadar Idris. In height it is the second in Wales. It rises on the seashore about a mile above Torvyn. Its ascent is gradual, first in a northerly direction for about three miles, then for about 10 miles east-north-east. From its summit, a branch spreads out in a south-west direction, nearly three miles long, which is parallel to the main ridge. On all sides it is steep and craggy, but the southern side is almost perpendicular. It is about 3540 feet above the level of the sea, which is 80 yards higher than most of the mountains in Cumberland. On the east of North Wales, the hills do not attain nearly such great elevation, gradually declining to the hills of Shropshire, which have been already noticed. In South Wales, a chain proceeds to near Cardiff; its direction is nearly south, a small branch diverging to the west: this chain is of far inferior elevation. On the east of South Wales, are the hills of Herefordshire.

The Devonian range of mountains passes through Devonian part of Somersetshire, through Devonshire and Cornwall, and terminates at the Land's End. The highest part of this range is formed by the mountains of Dartmoor in Devonshire, the altitudes of the principal eminences being from 1500 to 1800 feet. On approaching this tract from the south and south-east, the eye is bewildered by an extensive vale, exhibiting gigantic tors, large surfaces covered with vast masses of scattered granite, and immense rocks. Dartmoor, and the waste called the Forest of Dartmoor, occupy the greatest portion of the western district, and include between 200,000 and 300,000 acres of uncultivated land; of these Dartmoor alone is supposed to comprise upwards of 60,000. In the highest parts to the north and west are vast tracts of wet swampy ground, which supply the inhabitants with peat for fuel. From Dartmoor the chain extends to the extreme of Cornwall: the only other hills in this range are the Mendip hills; they are situated in Somersetshire, stretching from Whately near Frome, Selwood on the east, to Axbridge on the west, and from Redminster on the north, to Glastonbury on the south.

It has already been mentioned, that the breadth of the island may be supposed to be determined in the southern and eastern parts by two ranges of hills, across the considerably lower than that range, which determines.
its length; according to some, one of these chains extends from Dorsetshire to Kent, while the other is represented as stretching from the isle of Portland to the Wolds. According to others, the three loftiest and most naked ridges of the south-eastern quarter of the island, commence on Salisbury plain, an amazing extent of high and chalky land, stretching 25 miles east to Winchester, and 28 miles west to Weymouth; its breadth, in some places, being from 35 to 40 miles. The first of the ridges which takes its rise from this quarter, after intersecting Hampshire and Sussex, terminates at Beachyhead; that part of it which lies in Sussex, forms the famous South Downs, which are nearly 50 miles long, and about five or six broad. The second ridge extends to the eastern shore of Kent, and forms the Surrey hills or downs, little less celebrated for the goodness of their sheep-pasture than the South Downs. A little to the east of Farnham, in this county, they are merely a narrow ridge, called the Hogsback; but as they penetrate more deeply into it, their breadth becomes considerable; their southern side, in general, is steep; their northern, gently sloping. The third range, which, by some, is supposed to take its rise on the Wiltshire downs, crosses Oxfordshire, &c. into Norfolk. The hills of Gogmagog in Cambridgeshire, belong to this range. The Chiltern hills, another upland tract of considerable elevation, extend from Tring in Hertfordshire to Henley in Oxfordshire.

The most extensive and celebrated moorlands are those of Northumberland; of the five counties, as Mr Marshall denominates them; of Lancashire; the eastern and western moorlands of Yorkshire; and the moorlands of Staffordshire. The moorlands of Northumberland may be divided into the western and the southern; the latter, however, unite with, and therefore properly belong to the moorlands of the five counties, according to Mr Marshall's arrangement. The western moorlands occupy more than one-third of the surface of the county. The north Tyne rises in their north-western quarter, and runs nearly through the middle of them.

The moorlands of the five counties, of Durham, Northumberland, Cumberland, Westmorland, and the northern part of Yorkshire, form one united mass of mountain heights, which is separated, on the north, from the main body of the Northumberland moorlands, by the valley of the Ithling, and on the south by the valley of the Greta, from the western moorlands of Yorkshire. The moorlands of Lancashire are separated into two divisions, by the valley of the Ribble. The northern division is insulated, being separated from the western moorlands of Yorkshire by Craven, and the district which intervenes between Craven and Lonsdale. This district forms their boundary on the north; on the west, they are bounded by the cultivated lands of Lancashire. The southern division of the moorlands unites itself with the southern range of the mountains of the north of England, which has been already described. The eastern moorlands of Yorkshire are bounded, on the west, by the vale of York; on the east, by the sea coast district of the north riding of this county; on the north, by the vale of Stockton; and on the south, by the limestone lands of east Yorkshire. Their extent, if the valleys which lie among them are taken into the calculation, may be about 400 or 500 square miles. The elevation of this minor class of English mountains is much below that of the Cumberland mountains. Their surface is tame, their soil poor, and in natural economy they resemble the moorlands of Northumberland and Durham, rather than those of the west riding of Yorkshire.

The western moorlands of Yorkshire, which form a tract of black, heathy mountains, are bounded on the north by the valley of the Greta; on the south, they are divided from the more southern mountains of the north of England, which have been already mentioned, by the manufacturing district, and by the valley of the Ayre; on the north-west, they extend into Westmoreland and Cumberland; on the west and south-west, their boundary is formed by the district of Craven, which contains the mountains of Ingleborough and Whernside, already described as forming part of the great northern chain on the east; these moorlands shelve down to the cultivated lands that constitute the western bank of the vale of York. The elevation of the western boundaries of these mountains is very considerable; inferior, indeed, to the elevation of the Cumberland mountains, but much greater than the elevation of the eastern moorlands of Yorkshire. Their surface, however, is tame, merely swelling: from this character, indeed, must be excepted their western margin, which is much broken, and strongly featured.

The moorlands of Staffordshire lie on the northern part of that county, to the north of a line drawn from Uttoxeter to Newcastle under Lyme. Their elevation must be considerable, as some of the numerous streams which take their rise in this tract of country run into opposite seas. That part of them which lies between Cheadle and Oak-Moor, consists of an immense number of rude heaps of gravel, thrown together without order or form, into sudden swells and deep gams. To the north of Oak Moor the calcareous part of the moorlands begins, reaching in length from the Weaverhills to Longnor, and in breadth from Dove to Morridge, and including fifty or sixty square miles. This is the best part of the moorlands; the worst part lies north-east of Mole Cop, and west of Leek. The summit of some of the hills in this district terminate in huge tremendous cliffs, particularly those called Leek rocks; here single blocks of immense size are heaped together; and some of prodigious bulk have evidently rolled from the summit, and broken in pieces.

The Wolds of Yorkshire have already been mentioned as being considered by some to be the northern extremity of the chalk hills of England; and, indeed, their natural character is the same as the chalk hills of the southern counties, but their termination differs from that of their western extreme. Here they end abruptly, in tall, steep, cliffs, the mass having the appearance of having been impelled in a southern direction; there the extremity is more shelving, broken, and irregular, fragments being found insulated, and scattered at several miles distance from the body of the hills. The outlines of the wolds are irregular; with respect to their extent, if they are measured from the vale lands of Holderness to those of the vale of York, and from those of the vale of Pickering to the now calcareous lands at their southern extremity, cannot be less than 500 square miles.

In elevation, surface, soil, and substrata, the wolds are very similar to the chalk hills of Kent, Surrey, Sussex, Hampshire, Wiltshire, and Dorsetshire.

In describing the sea coast of England and Wales, we shall begin with the mouth of the Thames, and proceed northward. The mouth of this river is formed by the Naze, a hooked promontory in Essex, to the south of Harwich, and the North Foreland, in the county of Kent, or, perhaps, more accurately and strictly speaking, it may be fixed at the Nore, between Leigh in Essex, and Sheerness in Kent. The coast of Essex from the mouth of this river, thus defined, receding, turns abruptly to face the east, and is indented by the bays that are form-
Of Suffolk.

The coast of Suffolk rises in a wavy line towards the north, a little inclined to the east. The first promontory we come to is Orfordness, a low beach running out into the sea. The town of Orford, formerly a sea-port, is now at some distance from the sea. Dunwich and Aldeburgh, on the contrary, have been almost washed away by the sea, which began its encroachments before the Norman Conquest. From Orfordness to Southwold, the coast lies due north, with a bold shore; a little to the south of the latter place, the sea, breaking in upon the shore, forms a creek, which, spreading out, divides to Dunwich, Southwold, and Walberswick. The bay before Southwold is Solebay, the scene of the great sea fight in 1672, between the Dutch under De Ruyter, and the English commanded by the Duke of York. This bay was formerly bounded by Eastonness, and another cape to the south-east of Dunwich; but the sea has removed these marks, and consequently changed the mouths of the bay. From Southwold northwards, the coast is much embarrassed with shoals, and presents nothing remarkable, till we come to Lowestoffe, which is built on a cliff above the sea, at the most easterly point of Great Britain. The whole extent of the coast of this county is about 60 miles; for the most part, it is composed of leamy cliffs, which, being undermined by the waves, are continually falling down; in some parts, however, there are hillocks of sand, and in other parts, especially near the borders of Essex, it is flat and marshy.

Of Norfolk.

The Norfolk coast, to the north of Yarmouth, runs out in a point into the German Ocean. This point is called Winterton Ness. Beyond it the coast tends west-north-west, and then west, the shore being low and flat, besiegued with dangerous sands, especially between the Ness and Happisburgh. The most remarkable of the banks of sand, which lie off at sea, run parallel to the coast of Yarmouth, and form the celebrated Yarmouth Roads. From this place, however, north-west to Cromer, and thence to Sheringham, there are steep and high cliffs, from 40 to upwards of 80 feet perpendicular. Proceeding westward the shore is low and flat; but about Hunstanton achange takes place. The Wash lies off and cliffs appear again. At Lynn Regis the great bay is formed between Norfolk and Lincolnshire, which indents the country deeply to the south-west. The sea coast of Norfolk is formed either by clayey cliffs, which are continually sapped and overthrown by the waves, or by low sandy shores, covered with loose pebbles. In some places, a kind of natural bank is formed of the sand, held together by the roots of the sea-reed grass. Hunstanton cliff, already mentioned, is the only rocky eminence on this coast. It is composed of chalk and friable stone, resting on a base of iron coloured pudding stone.

Of Lincolnshire.

After crossing the Washes, the main land of Lincolnshire presents its extended coast, in the form of a bow, to the German Ocean. In general, it lies low and flat, or with a small declivity to the east. In some parts, the land has been gained from the sea, though in other parts, the sea has in its turn invaded the land; and the remains of a forest are visible under the waves. Its sea-ports, which were formerly numerous, are now almost entirely choked up with sand, and some of them are quite deserted by the ocean. The coast of Lincolnshire at first stretches a little to the east of the north, and then gradually inclines to the west, to the mouth of the Humber. Its extent is upwards of 100 miles.

The extremity of Holderness, in the East Riding of Yorkshire, contracts into a small neck of land, forming a curve in the sea, towards the south-west. The extremity of the neck of land is the Spurn Head, a sickle-shaped promontory, that guards the mouth of the Humber, nearly opposite the port of Grimsby in Lincolnshire. Amidst the sands of this river, Sunk Island is formed on the Yorkshire side. In this part of the coast of this county, several ports have suffered from the sea. Headon, which was a free burgh in the reign of King John, and which, in subsequent times, was so populous as to have three parish churches, is now dwindled into a small and insignificant place, with scarcely any harbour. The coast continues low and flat, like that of Lincolnshire, till it has passed the little port of Hornsea, and approaches the quay of Bridlington. This sea-port is covered by the point of land called Flamborough Head, from north-east and north-west winds. Flamborough Head is formed by the Wolds, which here advance towards the coast. It is a very remarkable promontory, the white perpendicular cliffs of which protrude themselves far into the German Ocean, and serve as a direction for ships. Many of the rocks which compose it are insulated, of a pyramidal form, and soar to a great height. The bases of most of them are solid; but some are pierced through and arched. On the north side, there are large caverns. Beyond Flamborough Head, a rocky promontory, of a round figure, projects into the sea, by which it is surrounded on all sides, except on the west. On the summit of this rock is built the castle, and on the side of it the town of Scarborough. The shore here is remarkably bold; and the height of the cliffs gives it some resemblance to the coast near Dover. Between this place and Whitby, Robinhood's bay lies: the land is still high, and the sea deep, but the bay is exposed to the east wind. The Eastern Morelands extend over the whole country, to the north of Scarborough, to the coast, one deep hollow of which, formed by a small river, is occupied by the port of Whitby. From this place the shore declines west-north-west, and west by north. The next conspicuous point of land is Hunley cliff; beyond this, still more to the north, appears Redcliff, that makes one side of a bay, as the promontory, on which Hartlepool, in the county of Durham, stands, does the other; the River Tees rushing with a rapid tide into the German Ocean between them. From this description of the coast of Yorkshire, it will be seen, that from the Humber to Flamborough Head it is low and flat, and from Flamborough Head to the Tees uncommonly bold and precipitous. In the first division of it, it is in general composed of clay. Flamborough Head is limestone. Whitby presents a coast composed of aluminous schistus. There are many fishing villages on the northern part of the coast of this county, singularly placed, like nests, upon the ledges of the rocks. No coast in England furnishes a greater variety of fish than this.
land and the Ribble, is more extensive, as well as flatter than the former division; to the south of the Lune, the marshy tract surrounding Poulton, on the Wier, succeeds; afterwards the coast is indented by the great estuary of the Ribble, descending from below Preston.

In the last division between the Ribble and the Mersey, the Lancashire coast makes another swell; in no part is it bold or high, and, as it approaches the southern confines of the county, it becomes quite flat.

The sea coast of Cheshire is neither extensive nor interesting, being formed entirely of that broad neck of shire land, which stretches far into the Irish Sea, between the Mersey and the Dee.

The coast of North Wales, from the mouth of the Dee, is for a long space marshy; but near Holywell, in Flintshire, the mountains advance towards it, though they again recede and give place to marshes, at the termination of the vale of Clwyd. As we enter Caernarvonshire, the first object on the coast that presents itself, is the promontory of Llandudno, a steep precipice hanging over the sea, and stretching out far to the north, at the mouth of the Conway: this promontory forms one of the horns of a great bay, with Trwynder point in Anglesey, at the Menai Straits. Beyond the Conway is the once tremendous precipice of Penmaen-mawr, overhanging the sea, now safely crossed by a good road. The coast here is very rocky. The southern extremity of the coast of this country is formed by the peninsulated hundred of Lyn; here many sharp points of land run out into the sea, with bays between them. Off the most westerly point of this peninsula lies the small isle of Bardsey.

The Menai Straits, which separate Anglesey from Caernarvonshire, abound in peculiar beauties,—sometimes appearing landlocked, like a great lake, and at other times assuming the form of a large navigable river, flowing with several curves, nearly in a direction from north to south. The form of the island of Anglesey is nearly that of a parallelogram; that part of its coast which borders on the Menai Straits, is finely wooded; its northern, eastern, and western points, are sharp and narrow, and the southern angle is more rounded. The peninsula which stretches far to the west stands Holyhead; this peninsula terminates in a high mountain, hollowed by caverns, and frequented by falcons and sea fowl; from Holyhead, the shore inclines to the south-west, and thus completes the figure that the island forms. Off the eastern point, is the steep rocky islet of Priestholme; and off the northern point is another, called the Skerries, or the Isle of Seals.

The north-west horn of the great bay of Cardigan, which is the most considerable indenture made by the sea on the west side of our island, and which is equally distributed between North and South Wales, is formed by the coast suddenly turning round the point of Aberdaron. The sea coast of Merionethshire, which lies in this bay, is wild and mountainous: the only port in this county is Barmouth, on a little arm of the sea, into which several small rivulets discharge themselves. Below Aberystwyth, the coast of Cardiganshire fronts the west for some distance, after which it diverges towards the north; the extent of this county along the shore is nearly 40 miles; it has suffered greatly from the depredations of the sea, having been formerly celebrated for numerous towns, but containing now only a few poor villages. A promontory on the north of St David's, in Pembrokeshire, forms the southern horn of
the bay of Cardigan. The sea coast of Pembrokeshire is in general hilly, with steep or perpendicular cliffs: its north-eastern point is at the mouth of the Tivy. The first remarkable place is Aberkluk Bay, formed by Kennace Head on the north, and Pendower Head on the south; next succeeds Newport Bay; and after that Fishguard Bay: hence the coast tending to the south-west winds round Strumble Head, to that of St David's, off which lies Ramsey island, together with a group of rocks called the Bishop and his Clerks; these are frequented, in the breeding season, by vast numbers of sea fowl, many of which are unknown in every other part of the island. The large bay of St Bride's succeeds; and beyond some islands which lie on its southern side, is the entrance to the celebrated Milford Haven; this is an inlet of the sea, indenting deeply the southern coast of Pembrokeshire, and occupying a large space of that county, with its great basin, and the different creeks into which it branches off. It is fed by some inconsiderable streams from the interior of the country, few of which are dignified with any certain appellation, though most of them from small rivulets become extensive estuaries, when they unite with the main basin. Near Pembroke Castle, Milford Haven expands, inclining chiefly to the west, but near its mouth, turning abruptly southward; and when viewed from within, appearing perfectly land-locked: the ports of Hherbronster, Haiken, and Milford, occupy one of the many bays near the centre of this great sheet of water. The view of Milford Haven would be much more picturesque, if it were not for a deficiency of wood: it also loses much of its effect from the want of grandeur in the surrounding hills.

Beyond Milford Haven, the coast of South Wales continues rocky: it is also full of coves and remarkable apertures, to the entrance of the bay of Caermarthen. The northern horn of this bay is formed by the rock on which Tenby is situated: the opposite horn, by the point of Penrhyn Gwyne,—the extremity of that singular peninsula in Glamorganshire, that is called Gower. On the other side of this peninsula lies the bay of Oxwich, and still lower the bay of Swansea expands itself.

The greatest part of the sea coast of Glamorganshire swells into a semicircular sweep, but the western extremity is formed into a narrow beak, between the open channel, on the one hand, and an arm of the sea, which runs round to the Caermarthenshire coast, on the other. Beyond the bay of Swansea, the shore presents the castles of Dunraven, St Donats, and Fliemuni: the bay of Glamorgan next succeeds; and from its shore the Bristol Channel being here much contracted, the heights of the opposite coasts of Devonshire and Somersetshire, between Ilfracombe and Minehead, appear finely elevated: the sea, which separates England and Wales, contains in this place the two small islands of the Steep and the Flat Holmes, which however are much nearer to the Welsh than the English coast.

The shore of Monmouthshire inclines chiefly to the south, verging at last towards the east: the first part of it is marhsy and low, but as we approach the Wye, it becomes rocky and lofty.

The coast of Somersetshire receives the Bristol Channel into an extensive bay, which forms a kind of semicircle; and, if the indented outline of the shore is taken into the account, it will be found to stretch nearly 60 miles; at first it forms a broad plain, bordered by marshes, and it continues chiefly level, till it reaches the bay of Minehead, where the majestic pile of Dunster Castle appears powerfully elevated. From this the coast of Somersetshire, together with that of Devonshire, which soon joins it, may be called mountainous, abounding in dark cliffs and rocky hollows. The shore of the latter county extends at first to the west, and then turning to the south, the land is very irregularly indented, so as to form Barstaple Bay. It then again westward, and, afterwards advancing north, forms the bay which is called Portridge Mouth, at the extremity of which lies Hartland Point; the extent of the whole is rather more than 36 miles.

Soon after we pass Hartland point, the coast of Cornwall commences, the land declining to the south-west. The first place we meet with on the Cornish shore is Budehaven. A long range of broken coast succeeds to St Ives, its inclination being more and more westward from the south. After passing the semicircular bay of St Ives, the coast begins to turn, and after Cape Cornwall, the Land's End, the most westerly point of the island, makes its appearance. After doubling this point, the Cornish shore advances southward, with some swells to the east, and soon expands into the capacious bay of St Michael. The Lizard is the next remarkable object, a promontory that stretches out farther to the south than any part of the western coast of England, being somewhat below the 50th degree of latitude. The shore next inclines, for a short space, in a north-east direction, and then turning irregularly towards the south-east, becomes indented as far as the southern horn of the Ram's Head, which is opposite to the coast of Devonshire. In this part of the Cornish coast, there are several bays and havens, the most remarkable of which is Falmouth Haven; the estuaries of the Fowey and the Looe follow in succession; that of the Tamarr being the last and most important, where the harbour and Sound of Plymouth are formed between the shores of Cornwall and Devonshire.

Throughout that part of the English Channel, which runs from the entrance of Plymouth Sound to Portmouth harbour, the coast principally fronts the south: it is, however, deeply indented with various bays, that are formed by great projecting headlands. The harbour of Plymouth is double: the outer harbour, principally for merchantmen, lies beneath the Old Town, while the noble road, called the Sound of Plymouth, is formed by the confluence of the Plym and the Tamarr with the sea. Plymouth Sound opens to the south-east, opposite to the rock on which Eddystone lighthouse is built. The Eddystone rocks are a congeries of irregular rocks, situated about 12 miles from the middle of the Sound: they are so much exposed to the heavy swells from the Bay of Biscay and the Atlantic Ocean, that the waves frequently break over them with inconceivable fury. In consequence of the many fatal accidents that happened to ships, from running against these dreadful rocks, a light-house was erected on one of them in the year 1696: this stood many violent storms; but in the dreadful storm that happened on the 27th of November, 1708, it was blown down, and all within it perished. A second light-house was erected in 1708, and burnt in 1755. The present edifice, which was built by Mr Smeaton, and finished in the year 1759, is universally admired, for the mechanism and architecture displayed in its construction, and bids fair to hand his name down to a very late posterity as an engineer of the first rate talents and experience.

In proceeding to the east from Plymouth, the first bay that presents itself is Salcombe Haven: this was formerly a port of some note; at the head of the basin stands the town of Kingsbridge. Between the Hart
Point, one of the most celebrated promontories on the coast of Devonshire, and Froward Point, the bay of Dartmouth is formed; this is a spacious haven, capable of sheltering a large number of ships. The coast from hence winds to the north-east, and shoots out into a promontory called Berry Point, which makes one side of Torbay. The other side is formed by the promontory of Torquay. This bay is in its general form semilunar, inclining a circumference of about 12 miles; on both sides its shores are winding, and are screened with grand ramparts of rock; between these, in the central part, the ground from the inland forms a gentle vale, falling easily and gracefully to the water's edge. All round the bay, even on its rocky sides, wood grows with great luxuriance. This noble bay fronts the south-east: it has frequently afforded shelter to the navy of England. In the rocks which form the promontory of Torquay, there are various fissures of great magnitude, and some of them of singular construction: that of the greatest magnitude is called Kent's Hole; it is a vast cavern about 600 feet in depth.

Beyond Torbay, the small river Teign flows into the English Channel, and soon afterwards, the Exe: from the mouth of this river the Devonshire coast gradually turns to the south, as it unites with that of Dorsetshire near Lyme. The shore from hence turns to the south-west, terminating far to the south in Portland Island. Thus is it immense gulf formed, which includes the greater part of the south of Devonshire, and much of Dorsetshire, together with the several smaller bays of these counties, which lie between the Start Point and the Bill of Portland. To the north of Portland is a safe road for ships; but its southern point, called the Race of Portland, is one of the most dangerous places in the English Channel.

Immediately below this island, the Bay of Weymouth expands itself; on the opposite side of which, that part of Dorsetshire called the isle of Purbeck, stretches out, terminating in the point called St Aldhelm's Head. The eastern extremity of the coast of this county is called Peel Point, between which and another promontory, lying to the north, called Hand Fort Point, is included Swanage Bay. "Turning round the extremity of Purbeck, towards the north, the Bay of Studland is seen, the remotest headland of which extends to the mouth of the harbour of Poole. Opposite to this tongue of land is another promontory, but not quite so long, which shoots out from the main land of Dorsetshire. Immediately within the entrance between these, lies Branksay Island. There are several other small islands, round which the sea forms a vast body of water, constituting Poole harbour.

The Isle of Wight terminates the bay which is formed by the eastern extremity of Dorsetshire, with a vast range of cliffs in full front. The western side of this island is fenced with ridges of rocks, the most remarkable of which are those called, from their sharp extremities, the Needles. The appearance of these, and the advancing point of Hurst Castle on the opposite shore of Hampshire, afford strong grounds to believe, that in former times the island and the mainland were united. The southern coast of the Isle of Wight is edged with very steep cliffs of chalk and freestone, which, in various parts, are hollowed out into caverns. Between the island and the main land are several sand-hanks, especially on the eastern part, where is the safe road of St Helen's. Hurst Castle, which has already been mentioned, is situated near the extremity of an extraordinary natural causeway or point of land, which runs two miles into the sea in a south-east direction, and approaches the Isle of Wight within the distance of a mile. Through the strait which is thus formed, the tide rushes with very great force, and has deepened the channel no less than 28 fathoms. This natural causeway, at high water, scarcely exceeds 200 yards in breadth: it is a sterile beach, covered with loose gravel and pebbles. Towards the Isle of Wight, there is a bold shore, broken into ledges or terraces of pebbles by the violence of the waves; whereas, the other side, from its sheltered situation, is undulating, marshy, and undermined, forming the water, when the tide flows, into a smooth land-locked bay.

The coast of Hampshire, adjoining to Dorsetshire, of Hampshire, fronts the south-west, as the Avon descends by Christchurch. The bay of this name is formed by that river and the Stour, which unite their streams a short distance below the town. The western termination of the bay is Hengistbury-Head, generally called by the seamen Christchurch-Head, from its apparent connection with that place, as viewed from the sea. It is a bold headland, about a mile from the extremity from which the cliff dips for a considerable distance, and the estuary of the Stour and Avon is there only separated from the sea by a narrow neck of land. A little to the east of this is Lymington Bay, from which, till we reach the mouth of Southampton Water, nothing remarkable presents itself.

Southampton Water, or Trissanton Bay, is a large inlet of the sea, commencing at Calshot Castle, and stretching to the north-west upwards of 10 miles: it is navigable to the head for vessels of considerable burden. Its shores are extremely beautiful and picturesque, being lined on one side by the New Forest, and on the other by the ruins of Netley Abbey.

The English Channel, after the junction of Southampton Water, turns round the northern point of the Isle of Wight, gradually making its compass, till the coast of Hampshire fronts the south-west, opposite to that part of the Isle of Wight where the river Medina enters the sea. Between the island and the shore of Hampshire, is the noted road of Spithead: it lies directly opposite to the narrow neck of land on which the town of Gosport stands.

As we proceed to the west from Portsmouth-harbour, the coast is indented with another large basin, interspersed with various islands. From this basin, several branches run up into the country, one of them forming the harbour of Chichester. This basin is filled in by the small river Lavant, which flows by that city in a southward direction. The coast here is extremely level, and continues so towards the south, till it is terminated by the bill or peninsula of Selsey. A little further on, a few low rocks appear in the sea, near Bognor, but the coast becomes again low and marshy near Littlehampton. As we proceed to the east, the South Downs form a nearer back-ground, and at length advancing close to the coast, break into stupendous cliffs, till they are terminated by the bold point of Beachy Head. This promontory lies between Hastings and Shoreham, projecting perpendicularly over the beach, from which it has its name. It is the highest on all the south coast of England. It is noted for shipwrecks in stormy weather, and has several caverns made in it by the sea.

Beyond Beachy Head, the coast turns to the north-east, and becomes a sandy and marshy level near Pevensey: it continues of this description till it reaches...
The coast of Kent, adjoining to Sussex, is flat, abounding in sand and pebbles, and continues so till we pass Sandgate. Here the hills close in; a steep and downsward tract succeeds, descending from the interior of the county in a fine ridge, and terminating in abrupt chalky cliffs. In one of the hollows of this range, Folkestone stands between Dover Castle and that cliff so strikingly described by Shakespeare. A narrow semicircular range of cliffs is formed, that recedes a little from the coast. Beneath this range the town of Dover occupies all the space open to the sea.

The coast of Kent continues formed of high chalk cliffs, occasionally sinking into hollows, till we come to the headland called the South Foreland: from this point the shore fronts the east, receding, so as to surround a large sandy area, which appears to have been left by the sea. This flat tract is terminated in front by the high grounds of the Isle of Thanet.

The Downs.

Between the South and the North Foreland, are the Downs, a greatly frequented road for shipping: they extend about six miles. Off the Downs lie the Goodwin Sands, distant from Deal five miles, extending north-north-east and south-south-west about 12 miles. They are supposed formerly to have made part of the Kentish land, (though this is denied by some), and to have been overflowed about the end of the reign of William Rufus, or the beginning of that of Henry I. These sands are very dangerous for vessels riding in the Downs, which, in high winds, are frequently driven upon them. They are divided into two parts by a very narrow channel: in many parts they are dry at low water, and in some places even before that time. The northern division is of a triangular form, lying north and south towards the sea, and running away south-east to meet the east side, while it tends on the south to the Isle. This part of the sands is about 3½ miles long, and 1½ miles broad: the north end, called the North Land Head, is about six miles from the coast; the west end, which is called Blunt Head, is very dangerous. The largest place that dries on this sand, is called by the seamen Jamaica Island. The south part of the Goodwin Sands is 2½ miles in length, and, at the north end, not above a mile in breadth, from whence it gradually diminishes towards the south-west, till it ends in a narrow point called South Land Head, which is only three miles from the coast. These sands are altered more or less every year, by storms and strong tides.

The South Foreland forms the eastern point of the Kentish shore: two light-houses are erected on it, in order to warn mariners who arrive from the west, of their approach to the Goodwin Sands. The North Foreland forms the north-east point of the Isle of Thanet, and is, by act of parliament, ascertained to be the most southern part of the port of London. This headland projects into the sea nearly in the form of a bastion, and is somewhat higher than the adjoining coast: a light-house is erected on this, as well as on the South Foreland, for the general safety of mariners, but more particularly in order to enable them to avoid striking on the Goodwin Sands. This light-house belongs to Greenwich Hospital; and every British vessel sailing round this point pays 2d. per ton, and every foreign vessel 4d. per ton, towards its support. In this part of the coast of Kent, the sea gains so much upon the land, that above 30 acres have been lost within the memory of some now alive. All vessels passing on the south side of this foreland, are said to enter the Channel; and all the towns and harbours between London and this place, whether on the Kentish or the Essex shore, are called members of the port of London.

No circumstance connected with the progressive geography of England is more interesting than that which relates to the Isle of Thanet. We trust, therefore, we shall be excused for dwelling rather at length on its ancient and present state. At this day, it is scarcely a peninsula, and yet, in the time of the Romans, it was a complete island, nearly of a circular form. At this period, the sea on the south-west side, between the island and the main land of Kent, was at least four miles broad, gradually decreasing as it passed along the south side of the island, till at length its breadth contracted to two miles; and at Sar, which was the narrowest part, it was not more than a mile and a half. Thus far flowed the South Sea: the latter entered at what was, from this circumstance, called Northmutha, or North-Mouth. The direct and accustomed passage to London by sea, lay through the strait between the Isle of Thanet and the main land of Kent, as late as the middle of the 4th century. In the time of Bede, however, the breadth of this passage was considerably diminished; for he tells us, it was then but three furlongs wide, and so shallow, that it was fordable in two places. It continued, however, a passable strait for vessels of some size, till about the time of the Norman Conquest, when the inhabitants perceiving that the tide no longer flowed with any considerable vigour, began to erect dykes to keep it out, and thus brought about the present form and condition of the island. Thus the Isle of Thanet, which was formerly separated from the main land of Kent by the entire channel of what was called the Portus Hicupensis, and was then, in its natural state, all high land, is now a peninsula, or at most a river-valley, only, with the Stour-wantsome on the south, the Medway-stream on the south-west, and the Netherwantsome on the west. The other part of the island fronts the East and North Seas as before; but the figure is altered from a circular to an irregular oval. After the junction of the Isle to Kent, the sea, which no longer flowed with the same freedom, began to throw up immense quantities of beach on the opposite shore, which produced Estanore, that is, the East Stone Shore: this was originally an island, but the monks united it by a causeway to the Isle of Thanet.

Below this island, the coast of Kent, which still fronts the north, becomes marshy as it descends by Whitstable to the narrow arm of the sea called the Swale, which flows along two sides of the isle of Shepey. After this, the coast turns to the east till it reaches the point where the Medway terminates its course, by its junction with the Swale. Beyond this the fort of Sheerness projects, and the mouth of the Thames opens.

Of the rivers of England, the most celebrated and important are the Thames, the Severn, the Mersey, the Dee, the Tyne, the Tees, the Trent, and the Medway. As most of these flow through more than one county,
The sources of the Thames are generally admitted to be four rivulets, that rise in different parts of the Cotswold Hills in Gloucestershire, viz. the Lech, the Colne, the Churne, and the Isis. The last, which is the most important, and which retains its name the longest, after receiving the two other streams, becomes navigable; but for a considerable space the navigation is tedious and difficult, on account of its winding course, and its prevailing shallows. The country through which the Isis flows at first is not pleasant or interesting, as it pursues its way almost unseen, in the middle of an unvaried plain, first towards the east, and afterwards inclining to the north. After being augmented by two small streams, it turns suddenly to the south, and the plain now expands into a spacious amphitheatre, bounded by some striking hills, in the centre of which Oxford appears in sight. At this place the Isis divides into several small channels, leaving this city on the left: the branches, however, soon reunite, and the river turns round the city towards the north-east. Below Oxford it is joined by the Cherwell, which, passing on the eastern side of that city, together with the Isis, nearly insulates it.

The windings of the river through the great level which it flows through, after passing Oxford, are frequent; but the general direction of its course is to the south, with a small inclination to the east, as it passes the Berkshire hills, and the town of Dorchester in Oxfordshire. A short distance below this place it is joined by the Thame. This river takes its rise from several small streams, some of which descend from the central parts of Buckinghamshire, others from the borders of Hertfordshire, and many from the lower parts of Oxfordshire. After the junction of the Isis and the Thame, this river obtains its proper name, being originally called Thame-isis from this circumstance. From Wallingford to Pangbourn the inclination of the stream is almost due south; at the latter place it begins to form a considerable circle by the east to the north, below Reading, till it reaches Henley; after passing this latter place it inclines by the north-east to the south again, to approach Maidenhead; hence it winds in various directions, but generally south-east, till it passes Maidenhead and Staines. There it forms a vast circle by the south to the east, till it reaches Brentford; after which, as it approaches London, its direction, is, for the most part, to the north-east. In the vicinity of the metropolis it turns with a bold swell to the east: this direction it preserves, though occasionally varied by broad reaches, as they are called, till it falls into the sea.

In its passage the Thames receives no fewer than six considerable rivers that are not navigable, and eleven that are. Its course has been computed about 550 miles, of which it is navigable above 150 from its mouth. As far as Deptford it is navigable for vessels of almost any burden; to the pool for vessels of 400 tons; to London Bridge for those of 200. The tides flow up to nearly the distance of 50 miles from its mouth. The fall of water from Oxford to Maidenhead is about 25 feet in every ten miles; from Maidenhead to Chertsey 28 feet in the same distance; from Chertsey bridge to Mortlake 16 feet; from Mortlake to London about one foot per mile. Afterwards the fall diminishes more gradually, till the river unites with the sea.

The Thames is one of those rivers which rather derive their character from the country through which they flow, than impress their own character by their boldness and rapidity on the tract they pursue. It passes through some of the most beautiful, as well as the most fertile districts of the kingdom; but even where the country through which it flows is hilly, it never can be called a rapid stream; it is not, however, sluggish, but is more distinguishable for its majesty, and the purity of its waters, which generally fill its verdant banks, and are seldom discoloured by mud, except after great floods. When these occur, the whole country in the level parts of its tract appears like a sea; but the mischief which is thus occasioned, is much less than that produced by smaller and more rapid streams, when they overflow their banks. The part of its course most distinguished for romantic scenery or picturesque beauty, is that which stretches from Wallingford to Reading, Henley, Marlow, and Maidenhead bridge. About Henley in particular it sweeps through a rich and highly beautiful country, to which it adds a majestic and imposing feature; its valleys in this part of its course are bounded by hills richly clothed with beechwood, and finely embellished by the seats of many of the principal of the English nobility. Vast plains succeed, in which the Thames constitutes the chief feature. As it approaches London, its character changes, and the richness of nature gives place to evidences of the power, the wealth, and the skill of man. Mighty works of art adorn its banks, which abound in populous towns and villages. At London it is a superb tidal river, "full of vessels of every description, which arrest the eye strongly in the bold sweeps it afterwards makes, through increasing marshes to the sea, and to the end it preserves that air of placid dignity and imposing consequence, which distinguish so eminently this monarch of the British rivers."

The Severn, the second commercial river in the kingdom, has its principal source in a small lake on the eastern side of Plinlimmon, not far from the head of the Wye. At first it bears the name of the Hafren river, the name by which, through its whole course, it was known to the Britons. From this source it flows towards the south-east, and afterwards turns to the north-east, as it approaches Newtown, where it takes its proper name of Severn. Hence, through the delightful vale of Montgomery, its course is almost due north, till, entering the great plain of Shropshire beyond Welshpool, it turns abruptly to the south-east. Afterwards pursuing the same direction, it almost encircles the town of Shrewsbury. Flowing through the celebrated Colebroke dale, and passing Bridgnorth, it pursues a southerly course, as it leaves the county of Salop, and enters Worcestershire, at Bewdley. Here it again, a little lower, becomes a commercial river, being joined by those numerous canals which bear all the trade of Birmingham, Kidderminster, and the other manufacturing towns of Warwickshire, Staffordshire, and Worcestershire.
The Severn, now a broad stream, crowded with barges, flows through a pleasant country, between high banks, till it approaches the city of Worcester. It then traverses a part of what is generally called the vale of Evesham, though that name more properly belongs to the vale through which the Avon flows, between the fine ridge of the Malvern hills, and the bold rising ground of Bredon. After this, its banks become high and steep, so that it almost disappears as it flows through the vast plain of Gloucestershire. About a mile above Gloucester, it divides into two streams, which unite a little below that city, forming the tract of land called Alney Island. Soon after this junction, its depth and width are increased by several streams, as well as canals, from the clothing districts of this county. At a bend of the river, where the Strondwater canal joins it, it forms nearly a semicircle of ten miles, and flowing again south-west, grows gradually wider, till it receives the Wye near Chepstow, and the Avon from Somersetshire, thus forming the Bristol Channel. Between Tewksbury and the sea, there is only one passage over this river by bridge; this is at Gloucester; the other passages are by boats.

The Severn, particularly below Gloucester, has frequently overflowed its banks; and by sudden risings of the tide, occasioned much damage to the contiguous country. It is remarkable for its tide, which rolls in with a head three or four feet high, with a great noise. This arises from the circumstance, that it receives the waters of the great Atlantic Ocean with such considerable violence, as to fill the channel of the river all at once; and the opposition which the tides from the ocean meets with from the strong current of the river, occasions that dashing of the waves which is called the hygro or eage.

In describing the Mersey, it will be necessary to notice the origin and course of the Irwell, which contributes so largely to the waters of the former river. The Irwell rises in the moors that divide Lancashire from Yorkshire: it passes through the district of manufacturing towns in the former county, flowing at first westward, and then descending in a southward direction to Bury. Below this town, having been joined by the Roche, it makes a great curve to the westward again, till being joined by a small stream from Bolton, it turns suddenly to the south-east; this course it preserves till it reaches Manchester, where it is united to the Irk and the Medlock. From Manchester, its course is nearly westward, till its junction with the Mersey, which takes place near the village of Flexton. The Mersey derives its source from a conflux of small streams at the junction of Cheshire with Derbyshire; its course is considerably serpentine, but generally with an inclination to the south-west. The principal place it passes by before its junction with the Irwell, is Stockport. After this junction, the latter river loses its name, the united streams taking the appellation of the Mersey. Its course continues westward as it passes the town of Warrington, a little below which it forms a great arm of the sea, which, turning abruptly to the south west, grows a little narrower as it passes the port of Liverpool, near its exit. At that part of the Mersey where it swells into a basin, it is joined by the Weaver. This river rises in the northern part of Shropshire, and flows northward to Nantwich and Northwich, where it is joined by two rivulets, one from the northern confines of Staffordshire, and the other from Middlewich. After this junction, its course inclines to the north-west, till it falls into the Mersey, a little below Frodsham.

The Mersey, and the rivers which join it, have little of the mountainous character, except just about their source, as they soon reach a country abounding in manufactures, though not distinguished for beauty. The Mersey is navigable for very vessels of considerable burden, for about 35 miles from Liverpool to the mouth of the Irwell; and the latter river has been made navigable for boats, barges, &c. as far as Hunt's Bank, Manchester.

The Mersey and Irwell.

The Dee rises in the mountainous part of Merionethshire, from two rapid streams, which unite, and descending from the heights which separate Dolgelly from Bala, form the lake of Penible-meer, one of the largest in Wales. After issuing from this lake, the Dee pursues an easterly course beneath the town of Bala, and passing through the beautiful valley of Llangollen, with various windings, enters the great plain of Cheshire, beneath the park of Wyne Stay. Soon afterwards it changes its course, pursuing a northerly direction, forming a deep valley for itself through that plain; then crossing over to the city of Chester, it half encompasses its walls; and flowing from thence to the sea, it forms a broad sandy estuary, inclining to the north west, which divides Cheshire from Flintshire. By inland navigation, it has communication with the Mersey, Ribble, Ouse, Trent, Derwent, Severn, Avon, Humber, and Thames. It is navigable from near Ellesmere in Shropshire, to Chester; but at this city the navigation is rendered difficult and broken by a ledge of rocks running across the bed of the river, which form a kind of cascade.

The Dee is a most beautiful and romantic river: it is singular, from the circumstance that it increases its rapidity as it recedes from its source, being fed by numerous rapid streams from the surrounding mountains; one of which, called the Ceiro, precipitates itself down the curious falls of Glyndyfia. Perhaps the grandest view of the Dee is where it passes into the great plain of Cheshire, as the mountains recede, and lay it open to the view. It loses its romantic character as it approaches the city of Chester, and becomes a deep and tranquil river. At Chester it is discoloured by the tide; and though its windings are numerous, yet they are not picturesque, as it passes through a broad marsh before it swells into its grand basin.

The Tyne is formed from two branches, called the South and North Tyne. The former takes its rise on the borders of Durham and Cumberland. At first, its direction is northward, a little inclined to the west, by Aldstone; it then turns eastward to meet the North Tyne. This rises in the moorlands of Northumberland, close on the borders of Scotland; and being joined by the Reed, near Bellingham, pursues a south-west course, till it unites with the South Tyne. After their junction, the Tyne takes an eastward direction, and at last turning a little towards the north, falls into the sea beneath Tynemouth Castle.

The course of both the branches of this river is wild and romantic; till they reach Tynedale, when its character changes into a milder and more beautiful east. After passing Hexham, which occupies a central spot, near the junction of the two branches, the Tyne flows through a vale, rich in manufactures, as far as Newcastle. Here ships of moderate burden can come up; but the towns of North and South Shields are the proper ports of this river. Its estuary presents an intere-
The Trent.

The source of the Trent is contiguous to that of the South Tyne, in the vast moors which separate Yorkshire from Durham, Cumberland, and Westmoreland. At first it flows in a south-easterly direction; but beneath the town of Darlington, it turns abruptly to the north-east, and falls into the sea below Stockton, which may be considered its port. This river, flowing for a considerable part of its course through a wild and romantic country, bears the same character. During the latter part of its course, however, its character changes, and its banks are rendered busy and populous by a great variety of works. In many parts, they are fringed with wood of considerable growth and value.

The Trent deserves a fuller notice than we have given to any of the rivers, except perhaps the Thames and the Severn, on account not only of the length of its course, but also of the fertile districts through which it passes; the immense number of canals, by means of which it has an inland communication with almost every part of the kingdom; and the multitude of rivers, some of them of considerable size and note, which it receives in its course to the sea.

The Trent takes its rise in the hills beyond Newcastle-under-Lyme, in that part of Staffordshire that borders on Cheshire. At first, its course is nearly south-east; it then makes a sudden turn by the east to the north near Barton. From this place it divides Leicestershire from Derbyshire for a short time. It then crosses the south part of Derbyshire, and skirting the north-west part of Leicestershire, it enters Nottinghamshire a little below Thirsk. After passing Nottingham and Newark in a north-east direction, it suddenly turns to the north, near the latter town, and flowing past Gainsborough, enters Lincolnshire at East Stockwith; and about five miles below Burton-upon-Strather, falls into the Humber. It is navigable upwards of 100 miles.

The general character of the Trent is that of a full transparent stream. It flows among rich meadows, and through populous districts; but unless increased by floods, it is in no respect, and in no part of its course, resembles the rivers of the north of England. Soon after it passes Newcastle-under-Lyme, it meets with the numerous canals which abound in this manufacturing district; these frequently follow a course parallel with it, through the pleasant valley near Stone. After its junction with the Blythe, Taine, Soar, Dove, Derwent, and Erwark, it becomes a considerable stream, flowing through a range of beautiful and fertile meadows, bounded by finely wooded hills, and chequered with villages. After passing Nottingham, another rich vale receives it, with the hills of the forest of Sherwood on the left. Before it reaches the town of Newark, it divides itself into two streams, one of which washes the walls of that place, and the other passes by Kelham: the two branches again unite a little below, in a broad plain, which gradually declines in beauty as it becomes more level. Here the surrounding flat and sward permits the Trent to be distinguished. With the assistance of the tide, vessels of some burden can navigate it as far as Gainsborough. After passing this town, it flows through a range of fens, without any distinguishing feature, till joining the Yorkshire Ouse, the grand estuary of the Humber is formed, which divides Yorkshire from Lincolnshire.

Of the auxiliary streams which unite with the Trent, the Blythe is the first of any consequence. It rises a few miles to the eastward of that river, and pursues nearly a parallel course, till it joins it near King's Bromley. The Tame rises near Coleshill in Warwickshire, and after a short course, in which there is nothing remarkable, except the castle of Tamworth, it unites with the Trent a few miles above Burton. The Dove rises near the Peak in Derbyshire, and after various windings, generally inclining to the eastward from the south, it falls into the Trent below Burton. This river is very romantic in its character for a considerable part of its course, particularly where it forms the dell of Dove-dale. It afterwards flows through more expanded vales, and joins the Trent near Burton. Near Sawley, on the borders of Leicestershire and Nottinghamshire, the Trent is augmented by the Derwent, which also rises near the Peak of Derbyshire, and pursues a course nearly parallel to that of the Dove to Derby, where it inclines to the east. The features of this river are still more peculiar and extraordinary than those of the Dove. The Soar is a river of an entirely different character, rising westward of Hinckley in Leicestershire, passes through a rich grazing country, and more than half encompasses the ancient town of Leicester; after which, it receives the Wreke from the north-east, and then turns to Mount Soar Hill, where an abrupt rock, (an extraordinary feature in so level a country), overhangs it, watering, in its course, meadows of extraordinary beauty and fertility, till it falls into the Trent, not far from Cavendish Bridge.

Yorkshire also supplies various streams, to increase the size of the Trent. The Don rises in the high moors of this county, near the confines of Derbyshire. It takes a south eastern direction to Sheffield, and then turns north-east by Rotherham to Doncaster. At Thorne it alters its course to the north, and soon after joins the Northern Ouse. The character of this river does not correspond with its mountainous origin, except very near its source. Near Doncaster it forms a most beautiful vale, but after passing this town, it sinks into an extensive flat and tame country, which environs the Ouse. Just before its junction with this river, it is divided into two branches, the lower of which appears to be a navigable cut, and is called the Dutch river. The Calder rises in Yorkshire, near the borders of Lancashire. Its course is very winding, but nearly in an easterly direction, till it reaches Wakefield; it then turns to the north, and joins the Ayre near Ferrybridge. This river is more rapid than the Don, but is more remarkable, from the circumstance of the numerous canals by which it is intersected, and which form a junction between the eastern and western seas, than by any peculiar feature. The origin of the Ayre is mountainous, a little to the north-east of Settle, in Yorkshire. It pursues a course to the south-east, nearly as far as Leeds, where it turns nearly eastward; after its junction with the Calder, it traverses a flat country, and receiving the Don, joins the Ouse near Howden. The district of Craven, through which it flows in the first part of its course, is singularly romantic; while at Leeds its character is entirely changed, its banks being covered with the various manufactories of that place. Between Leeds and Ferrybridge, it divides one of the richest plains in the kingdom; afterwards it possesses little beauty, passing through a level country, to join the Ouse, not far from the Don.
The Ure, and the Swale, which may be regarded as the parents of the Ouse, rise near each other in the romantic borders of Westmoreland. The Ure flows at first eastward, and then inclines to the south to Rippon; from this place it turns again more to the eastward to Boroughbridge; and at Aldborough it unites with the Swale. The character of this river, through most of its course, is that of a mountainous stream; and this character it particularly displays in its passage through Wensley-dale. The direction of the Swale, at first, is to the south-east; it afterwards turns to the north-east to Richmond, and from this place it pursues nearly its original direction till it joins the Ure. The country through which this river flows is uncommonly romantic, till it reaches the great vale of York. Swale-dale, and the view of the river from the castle at Richmond, are particularly celebrated.

These two rivers, after their junction at Aldborough, take the name of the Ouse. From this town, its course is nearly south-east to York, south to Cathwood, where being increased by the junction of the Wharfe, it turns again to the south-east, and pursues that direction, with various windings, till it meets the Trent, and forms the Humber.

The Humber is a name almost exclusively given to the great estuary that divides Yorkshire from Lincolnshire, being formed, as we have seen, principally of the Trent, and the Ouse, and of the streams which fall into these two rivers.

The river Medway rises from four sources; the first at Crowherst in Surrey, the second at Stewards-meal in Sussex, the third at Goldwell, and the fourth at Biggenheath, both in Kent. The first three soon unite their waters, and take a north-east direction to Tunbridge and Maidstone, at which latter place they are joined by the fourth stream. The tide flows up hither, and the river is navigable for barges and other vessels of the burden of fifty tons. After passing Maidstone, the Medway turns with a long compass by the north to the east, to reach Rochester and Chatham. Between this place and Gillingham, which is about a mile and a half to the north-east of it, some of the largest ships in the royal navy are usually laid up. Afterwards it winds with various curves to the eastward, till it joins the arm of the sea called the Swale, (which divides the isle of Shepey from the main land of Kent,) and then turning again northward, it enters the Nore near the mouth of the Thames, under the fort of Sheerness. Its whole course is about 40 miles; and that circumstance considered, it is perhaps one of the deepest rivers in Europe.

During the first part of its course, it is so buried within its banks, that it adds little to the scenery of the country through which it flows; but between Tunbridge and Maidstone, the valley expands, and the character of the river is seen in its true light. This character is still more marked, after it winds round the decayed town of Aylesford, and becoming suddenly a bold and wide stream, flows with considerable rapidity under the arches of the ancient bridge of Rochester. Below the bridge, it takes a broad sweep, and when increased by the tide, exhibits, in connection with the superb buildings and dock of Chatham, and the great ships within it, a grand and striking spectacle. From Chatham to its mouth, the banks of the Medway are marshy and uninteresting, till its approach to the sea is indicated by the immense number of masts which encompass Sheerness.

Besides these rivers which we have described, the following deserve notice. The Blackwater, which takes its rise near Saffron Walden, in Essex, and flowing by Coggeshall and Wetham, falls into the sea at Maldon in the same county. The source of the Chelmer is near that of the Blackwater; it winds through the middle of Essex, and passing Chelmsford, also discharges itself into the sea at Maldon. The Colne rises near Clare, in Suffolk, and after passing Colchester, falls into the sea between Mersey Island and the main-land of Essex. The Stour divides this county from Suffolk; it rises on the southern boundary of the latter county, and falls into the sea at Harwich; near its mouth it is joined by the Orwell, which runs up to Ipswich. Proceeding northward, the next river of consequence which we meet with, is the Waveney, which forms part of the boundary between Norfolk and Suffolk, and unites with the Yare a little above Yarmouth. This river is navigable from Bungay. The Yare, which falls into the German Ocean below Yarmouth, is navigable as high as Norwich. But the most important rivers in this part of England, are the Great and Little Ouse; the former rises on the borders of Northamptonshire and Oxfordshire. Its course, at first, is east, a little inclining to the north through Buckinghamshire; it then bends to the south, with many windings, and reaches Bedford, where it becomes navigable; it afterwards proceeds through Huntingdonshire, Cambridgeshire, and the Isle of Ely, to the county of Norfolk; and inclining more and more to the north, it falls into the Wash, beneath the walls of Lynn Regis. In its course, it receives the Nene from Northampton and Peterborough; the Cam, from Cambridge; the lesser Ouse from Norfolk; and the Macksonhall from Suffolk; all of them navigable rivers. The entire course of this river may be 100 miles. The character of this river through the whole of its course, is very tame and uninteresting. In the latter part of its course, it sinks into those great marshes that abound on this part of the eastern coast: The Welland has its source between Lutterworth and Harborough; and after flowing in a north-east and northerly direction, and separating Northamptonshire from Leicestershire, Rutlandshire, and Lincolnshire, it contributes to form the Wash of Fosdyke. The Witham falls into the sea at the same place, taking its rise north of Stamford, and pursuing a northerly direction by Grantham to Lincoln; it afterwards changes its course, and flowing first to the east and next to the south, its course is terminated near Boston. As the principal rivers which join the Trent have already been noticed, we shall proceed to the Wear. This river rises to the north of the Tees; at Bishops Auckland, it changes the south-easterly course which it had hitherto pursued, turns to the north-east, and after nearly surrounding the city of Durham, it flows northward to Chester-le-Street, and then inclines a little to the east to reach Sunderland.

As the Tweed is rather a Scotch than an English river, we shall proceed to a brief notice of the secondary rivers in the west of England. The Eden, the first English river on the south-west border of Scotland, has its source in the moors of Westmoreland; for a short way its course is to the north-east, after which it inclines to the north-west till it reaches Crosby, when it turns to the south-west to pass Carlisle; for the remainder of its course, its direction is again north-west. At its mouth it meets the Esk, and both rivers fall into the Solway Frith. The Ribble rises in the district of Craven; it flows in a south-easterly direction, till it has passed Settle, when it turns south-west by Clithero,

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where it enters Lancashire. After passing Ribchester, it enters a vale of considerable beauty, to which it gives name; it next compasses the handsome town of Preston, soon after which it discharges itself by a broad sandy outlet. No rivers occur (except such as have been already described) that need detain us between the Ribble and the Wye. This latter river rises on the south side of Plinlimmon, near the source of the Severn. It flows at first towards the south, with a trifling inclination to the east; and this direction it pursues through the great plain of Herefordshire; but as it approaches Monmouth, its course is south and south-west. It falls into the mouth of the Severn near Chepstow. The grandiose beauties of the Wye, which flows in a deep bed, between lofty rocks, clothed with hanging woods, and here and there crowned with ruined castles, have employed the descriptive powers of the pen and pencil, and frequently engage the curiosity of travelers.

Avon is a name which no fewer than seven rivers in England and Wales bear; but of these, only the Upper and Lower Avon, and the Avon of Wiltshire and Hampshire, call for our notice. Our account of the last we shall defer till we come to the rivers on the south coast of England. The Upper Avon rises on the borders of Leicestershire and Warwickshire, and, bringing a large influx of water past the castle and town of Warwick, it afterwards flows through a fine county to Stratford on Avon. From this place, it traverses the great level of Worcestershire, by Evesham, and, bending to the south, falls into the Severn near Tewkesbury. The Lower Avon has its source near Wotton Bassett, in the hills of North Wilts, bordering on the county of Gloucester. From these hills it flows with a winding course into the vale that leads to Chippenham; hence its windings are still greater and more numerous, the country through which it passes being very hilly. It next enters the clothing district of Wiltshire, and for a short space divides that county from Somersetshire. Its course is next to the south, and afterwards it takes a long compass by the west and the north. The city of Bath is now nearly encircled by its waters. From this place, with frequent meanderings, it descends to Bristol, whence it falls into the Bristol Channel at King's Road. The country through which the Lower Avon flows, is in general rich and picturesque; but its waters are frequently discoloured, after heavy rains, by the chalky soil of Wiltshire, and the ochry soil of Somersetshire.

The Tamar, one of the most considerable rivers in the west of England, rises in a moor near Marvingtow, the most northern part of the county of Cornwall: It pursues nearly a southerly course, by Taverton, to the vicinity of Launceston; at a small distance from which, its current is increased by the small river Ottery. After their junction, it inclines to the east, till it unites with the Lyd and the Tavy. It now resumes its south direction, and, uniting with Lynher-creek, and continually increasing in importance as it winds along, it forms, between Plymouth Dock and Saltash, the spacious basin called Hamoaze, or Plymouth Harbour, which has been already described. Its course, though short, is in many parts very striking; about Launceston, its banks are finely fringed with wood; while lower down it receives the character of grandeur, from the numerous large vessels with which its broad curving branches are crowded.

None of the rivers in the south of England so strongly resemble the bold character of the rivers of the north of England and of Scotland, as the Dart. It rises in the mountainous district of Dartmoor, and first descends southward, and then inclines considerably to the east before it leaves that part of the country. Afterwards its winding course is to the south-east, as it passes Totness, and falls into the sea between Dartmouth and Kingswear. It is particularly distinguished for its rapidity; and this character it retains even after it leaves those mountains which inclose its source. When it descends into the rich plains of the southern part of Devonshire, its character is changed; and a little to the west of Ashburnham, it forms a charming valley, through which it flows in a placid stream. At Totness it is joined by the tide, when its character again changes; now exhibiting, in a striking union, its original boldness and its subsequent beauty, rolling, in a majestic stream, between hills covered with vegetation, woods, and villages, disclosing new beauties at every curve, and presenting a grand object to the adjacent country, varied perpetually both in its form and attendant features. Nearer its mouth, the hills that inclose its channel become more lofty, while the river, winding between their wooded and rocky bases, passes the hamlet of Kingswear on its eastern, and the irregular town of Dartmouth on its western bank.

The Exe calls for our notice, more on account of its The Exe. beauty, than on account of the length of its course, or its importance. It rises in the hills of Exmoor, and at first inclines to the south-east; but afterwards entering a deep valley, it flows southward, with a little bending to the west, to Exeter. From this city, its course is rather to the east of the South, as it forms a gradual transition to Exmouth, where it meets the sea. The most striking circumstance attending the course of this river, is the sudden change of character which it undergoes, from a furious torrent to a placid rivulet, as it descends from its mountainous origin into verdant meadows. This striking change of feature takes place, when it forces itself a passage through the wild hills near Minehead, into a valley, whose sides are richly clothed with wood; but the valley through which it flows does not become expanded till the Exe is joined by the Culm. From their junction, it flows through a district of uncommon richness and beauty.

None of the rivers of Dorsetshire present any circumstance which calls for notice: their course is not long, nor is the country through which they flow distinguished either for much beauty or fertility. We shall, therefore, pass on to the consideration of the Hampshire and Wiltshire Avon. This river springs from three sources; one near Marlborough, and the two others between Marlborough and the Devizes. After these branches unite, the Avon flows to the South, forming a valley between Marlborough Downs and Salisbury plain. It passes by Amesbury, and under Old Sarum, to Salisbury. On one side of this city it is joined by the Willey, and on the other by the Bourne. After this junction, the Avon continues to flow in a southward direction, through a part of the New Forest, by Ringwood, till the Stour meets it at Christ Church, when it falls into the English Channel. By the aid of the tide, large ships go up to Christ Church; and a few miles above this place the navigation by locks commences, which continues to the vicinity of Salisbury. From this description of its course, it will be seen, that the country through which it flows is generally destitute of beauty, and not remarkable for its fertility; but
Ullswater is situated partly in Westmorland and partly in Cumberland. It is about nine miles long, but at its greatest width a little more than one. Its shores are uncommonly bold, and the falls which are in its neighbourhood rise with great sublimity; yet, notwithstanding the vastness of these accommodations, Ullswater retains a character of high and impressive dignity. This character is intermixed with one little less striking, though of a more mild and captivating nature: The rocks of the lake, and of its vicinity, are celebrated for reverberating sounds, so that, by the introduction of a few French horns and clarionets, according to Gilpin, "the whole lake is transformed into a kind of magical scene, in which every promontory seems peopled by aerial beings, answering each other in celestial music!" Thirlmere, or Leatheswater, is a narrow irregular sheet of water, about three miles in length. It skirts the huge base of Helvellyn; it is situated in the interior of a very sequestered district; and its shores being for the most part naked and rocky, it displays a scene of desolation, heightened in no trifling degree by the huge masses of stone which appear to have fallen from Helvellyn. The impression made on the mind and feelings by this scene, is deepened by the noise of the water-falls, which, on every side, are tumbling from immense heights. Derwent-water, or Keswick-lake as it is also named, is about three miles in length, and one and a half in breadth, somewhat approaching to an oval figure. In beauty it is superior to all the other lakes, but in dignity and grandeur it is much inferior to that of Ullswater. Its greatest blen- dish to the eye of taste, arises from its want of proportion, when viewed in connection with the scenery around it. This scenery is on a very grand and sublime scale; whereas the lake is not only too small to be grand, but also in its features and form excludes all idea of grandeur; for, being seen all at once, it leaves nothing for the fancy to feed upon. But, in respect to beauty, it has undoubted and large claims on the man of taste: "The soft undulation of its shores, the mingled wood and pasture that paint them, the brilliant purity of the water, that gives back every landscape on its bank, and frequently with heightened colouring; the fantastic wildness of the rocks, and the magnificence of the amphitheatre they form, are circumstances, the view of which excites emotions of sweet and tranquil pleasure." When visited by moon-light, the deep shades of the frowning mountains—the reflected light of the moon on the unruffled surface of the water—and the silence of the night, only broken by the murmurs of the water-falls, are represented as filling the mind with inconceivable pleasure.

About three miles to the west of Derwent-water, Brood-waite, Bassenthwaite-water, or Brood-water, is situated: it is ten about four miles long, and at one end nearly a mile across; but at the other end, its breadth is not more than a quarter of a mile. There are many points in the surrounding scenery, which give to this lake a striking character: on the east of it is spread the beautiful and extensive vale of Bassenthwaite, beyond which Skiddaw rears its lofty head; on the west, mountains, low in comparison with Skiddaw, fall abruptly to the water's edge, disclosing here and there small patches of cultivation, and partly covered with thick woods. The situation of Overwater is naked, and the country neither sufficiently picturesque or sublime, to engage the attention of such as have already viewed the beauty of Derwent-water, or the grandeur of Ullswater. It is about half a mile in length, and rather more than a quarter of a
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mile broad. Lowes-water is a beautiful lake, but its beauty is of a somewhat different character from that of Derwent-water; woodland and cultivated fields, finely intermixed, ornament its borders, while its southern shore is bounded by some lofty eminences, descending in some parts precipitately to the water: the northern shore is more humble, and soon softens into an open country. It is about a mile long, and a quarter broad. None of the lakes in this part of England have juster claims to the character of picturesque, than Crummock-water; the barren Mofflock, and other lofty mountains, border the western bank of this lake, while its opposite shores are much indented, and varied with low bays, curious promontories, little coppices, and trees scattered among small farms; the whole terminating in a rich scene of woodland, impending in a beautiful manner from the superior eminences. On each side there is a chain of mountains; some naked, others wooded to their bases; some verdant, some rocky and heathy, and some covered with red shiver, which streams down their furrowed sides, exhibiting a singular appearance. This lake is nearly four miles long; its breadth about half a mile; its waters are very deep and clear.

Buttermere. About a mile south from this lake, Buttermere-water is situated, being separated from it by a fine, level, and luxuriant vale. A range of rugged mountains, rising abruptly from the margin of the water, hem in its western shores; its eastern shores rise more gently, and are partly adorned with wood. This lake, though undoubtedly beautiful, is more deservedly celebrated for the cataracts which are near its southern extremity, and particularly for the water-fall, called Scale-force, about a mile and a half to the west of it. The length or Buttermere is rather more than a mile and a half, and its breadth about half a mile. Ennerdale-water is guarded on every side except the west, by wild and craggy heights, which are almost impassable. The terrific gloom of these objects is relieved and enlivened in some degree, by the small farms, which are scattered along its eastern shores; but, on the whole, the scenery is melancholy. This lake is about two miles and a half long, and its breadth, at the widest part, about a quarter of a mile. Wast-water is situated in the middle of Wasdale, on each side of which, the western mountains rise to a great height, and almost meet at their bases: the form and position of these mountains add greatly to the effect of the scenery of the lake: some lean from the opposite sides of the vale towards each other, so much as to render the distance between their tops, when contrasted with the distance between their bases, very singular and romantic; while others rise perpendicularly, covered with loose stones of different colours, which are continually falling down; and when, during their fall, the sun shines upon them, they are represented as somewhat resembling the Aurora Borealis. The character of the vale is quite different: here every thing is rural, and in the genuine style of pastoral beauty and simplicity. This lake is about three miles long, and about three quarters of a mile broad in the widest part.

The other lakes of Cumberland do not require particular description, as they present little that is grand or interesting. Burnmoor-tarn is seated among the wildest mountains at the head of Mertledale, to which there is scarcely a sheep tract to direct the steps of the curious traveller. The waters of this lake do not cover more than 250 acres. Devock-water is a little larger, occupying about 300 acres. It is situated among the hills, about five miles south-east from Ravenglass. Talkin-tarn includes a space of about 40 acres. This lake, as well as Tindale-tarn, which covers about 50 acres, is situated among the bleak moors, a few miles to the south-east of Brompton. Turn-wattdale spreads its waters on a naked and barren common, about one mile to the westward of the river Eden, at Arnthwaite, above which it rises 600 feet perpendicular. It covers about 100 acres.

Winandermore is a lake, that serves as a boundary between the counties of Westmoreland and Lancaster. It occupies an area of about 15 miles in length. Its average breadth is about one mile. Its greatest depth, near Eccles-cragg, has been ascertained to be 800 feet. In the middle of the stream, a smooth rock forms the bottom of this lake. The stream, in many places, are perpendicular, and in some they continue so for a mile without interruption. This lake is principally formed, or fed, by four rivulets. The Brothay and Rothay join at its west corner; and about four miles lower down, on the east side, Troutbeck river descends from the falls, and falls into the Mere. At Causey-beck, its waters are further augmented by a small rivulet called Estwaite-water. The waters of Winandermore fall generally with great rapidity, at its south end, which terminates at Newly-bridge, through the channel of the Leven water, and in their course form several cascades over the craggy rocks. The character of this lake possesses many striking beauties, with just so much of the romantic, as to vary and enliven those beauties. Its sides are finely skirted with rich and picturesque scenery, and the effect is greatly heightened by several small islands, some of which are ornamented with castellated buildings. Coniston lake is situated about four miles west from Hawkshead in Lancashire, is about six miles in its greatest length, three quarters of a mile in breadth, and in depth about 40 fathoms. It is chiefly characterised by the nature of its shores, which are frequently indented, and open into small bays, in a variety of forms.

Chap. III.

Meteorology of England.

With respect to climate, England, from its situation in the northern part of the temperate zone, cannot enjoy long, or in great vividness, the genial influence of the sun; and from its being an island, it is exposed to great variations of dryness and moisture, as well as of heat and cold, at all seasons; indeed, its atmosphere is inclined to be chilly and damp, and is therefore not so favourable to the ripening as to the growth of the productions of the earth. There is, perhaps, however, no country in Europe, which displays such a rich and beautiful verdure, for such a large portion of the year; since the rigour of its winter is seldom so great or so lasting, as to destroy this verdure by cold, and the rains of its summer, interrupted by cooler weather, and refreshed by frequent showers, do not wither up the grass. On the continent of Europe, the period when the different seasons may be expected to arrive, the mode in which they will respectively commence, and their durations uninterrupted by unseasonable weather, can safely be predicted and relied upon; but in England it is quite the reverse. The winter months, indeed, are generally reckoned to be December, January, and February. The spring months, March, April, and

General description of the climate.
May; the summer months, June, July, and August; and the autumn months, September, October, and November; but it never happens that the seasons respectively confine themselves to these months: not infrequently in the month of January or February, a foreigner, unaccustomed to our climate, would imagine that spring was about to commence; the air is mild and balmy, the buds begin to burst forth; the birds, which the rigour of winter had kept from sight, again make their appearance; and the whole face of nature seems to rejoice. This, perhaps, continues for the space of a week or two; when suddenly a gloomy change takes place, and winter resumes its power. Open and mild weather is also not unfrequently seen even in December, especially towards the beginning of that month; indeed, in all parts of England, little or no frost is expected before Christmas: this is almost the only circumstance respecting an English winter that can be anticipated with tolerable confidence; the nature of the winter, with respect to severity, and the duration of it, those who have had the longest experience of our climate, and paid the greatest and most minute and particular attention to its changes, and to the apparent or probable signs of its changes, are totally unable to predict.

In one respect, however, our winters differ even when they are most severe, from the winters of countries which lie under the same latitude on the continent; for while the sea-ports of Holland and Germany are every winter locked up with ice, those of England are never known to suffer this inconvenience.

We have said that December, January, and February, are generally reckoned the winter months; but as the weather in the two latter is not unfrequently much milder than proper and regular winter weather, so, on the contrary, the weather of what are called the spring months, March, April, and May, is very frequently the reverse of spring weather. March is almost always a wet and boisterous month, except in those few cases in which the rigours of winter extend into it. Its moisture is so great, as to have given rise to the English proverb, "a peck of March dust is worth a king's ranson." The month of April is usually mild and moist, and spring again, after having made a feeble effort to resume its authority in January or February, attempts, but too frequently with as little success, to establish its power; for May, which on the continent is the month of uncommon blandness, and to which, even in England, notwithstanding our almost uniform disappointment, we ascribe the same quality, seldom appears, or at least advances far, before easterly winds set in, which, to the feelings, are as cold as the coldest winds during the frosts of winter, and which most effectually in all cases check, and in many instances totally blast, the fruit vegetation.

Hence it appears, that, in England, the season of spring can scarcely be said to exist; certainly not to go forward, increasing in beauty and interest, till it expands into the season of summer. But though an English spring is thus uncertain, interrupted, and short, it has charms of its own, to which, in a great degree, the same season on the continent is a stranger; for there are almost every year, and nearly over the whole of England, days, and sometimes weeks, during which vegetation proceeds regularly, and without check, and when the air possesses all the balminess and mildness of summer, without its oppressive heat. Indeed, with respect both to the spring and summer of England, it may justly be observed, that, amidst all their uncertainty and interruption, they favour us with weather, such as, (it may be, perhaps, from the relish and contrast which that uncertainty and interruption create,) even at the period of their highest perfection, they do not exhibit on the continent.

The summer of England scarcely ever makes its appearance before the middle or end of June. The first part of this month, though occasionally mild, too often partakes of the cold easterly winds of May; so that, strictly speaking, May and the beginning of June fall under no division of the year. The weather, during the prevalence of the easterly winds, is as cold as that of winter; but it is not winter; and assuredly there are no signs of spring, while these winds continue. Generally, therefore, vegetation makes little advance towards the luxuriance of summer, till the middle or end of June. At this period, in the south of England, the country is uncommonly beautiful; but in the northern counties, the weather is still very often cold and ungenial. July, August, and September, may be said to be real summer months over the whole kingdom; but slight frosts sometimes occur during the nights of September, even in the southern; while, on the other hand, the month of October, in this part of England, is often mild, dry, and settled. In the northern counties, this month may be said to be the beginning of winter; or, more properly speaking, of that raw, unsettled, wet weather, which always precedes winter in this island. November seldom advances far, before it brings the same kind of weather to the southern counties, attended in London and its vicinity, with thick fogs and mists.

Such is the climate of England, generally speaking; but it will be necessary to be more particular, and to describe the difference of climate in the different parts of the kingdom. It is sufficiently obvious, that in the north of England, the spring, summer, and autumn will be more backward, less certain, and of shorter duration, than in the southern parts of the kingdom. The temperature there is not only colder, but it is also moister. The winters are likewise more severe, and of longer duration; so, that, to the north of the Mersey, and the Humber, the seasons of spring and summer may be reckoned to be nearly a fortnight later in their commencement, than they are in the south and southwestern counties, while the autumn is shorter, and more frequently interrupted with frosts during the night. It cannot be doubted, however, whether the winter in the north of England is more severe, when compared with the winter in the south of England, in the same proportion as the spring and summer are longer and warmer; at least, in the southern counties, particularly in those which lie in the vicinity of London, the winters are nearly equal in severity, though perhaps not in length, to the winters of the counties to the north of the Mersey and the Humber.

Besides the difference between the climate of the north and south of England, there is also a difference between the climate of the eastern and western counties. The climate of the latter is much more moist, and at the same time milder than the climate of the eastern counties. This circumstance arises from three causes: the vicinity of the western counties to the great Atlantic Ocean, the extreme prevalence of westerly winds, and the ridge of hills, already described, which runs along the western side of the kingdom. The Atlantic Ocean saturates the westerly winds with immense quantities of vapours, which being intercepted in their passage by the range of hills, fall in rain. The eastern side of the kingdom, not receiving these winds,
first, and, on the other hand, from being more exposed to the cold and piercing north-winds, its temperature is less pleasant, especially during the summer months. It is well known that the temperature of the ocean is more equable than that of the land; and, of course, at least in our latitudes, milder during winter, and not so warm during the summer; hence, the western counties, being exposed to the winds from the Atlantic Ocean, generally experience a winter rather moist than severe. Snow seldom lies in this part of the kingdom for any length of time. This remark applies with peculiar force to the south-western counties of England, particularly Cornwall and Devonshire, which being exposed to the winds both from the Bristol and English Channel, is favoured with uncommonly mild winters.

The science of meteorology is, even in this inquisitive and enlightened age, so little advanced, and so bare of facts, that it would be rash to attempt to give particular details, either respecting temperature, or the quantity of rain, which would be accurately correct, and unquestionably well-founded, except such as relate to some few districts of England and Wales. These, however, it may be proper to give, in order that a clearer insight may be gained into the nature of our climate, and into its difference in different parts, and its variations in the same part.

First, with respect to the quantity of rain which falls in different parts of England. It has been already observed, that in the western counties much more rain falls in the course of the year than in the eastern counties; and it may be added, that a greater proportion of rain falls on the north-western coast, compared with counties that are situated on the south-eastern side of the island. The proportion of rain which fell in the course of a year at Townley, in Lancashire, was measured, upwards of a century ago, and compared with the quantity which fell during the same space of time at Axminster, in Devonshire; on an average of six years, from 1700 to 1705, inclusive, it appeared that there fell at Townley 42.2 inches, while at Axminster there fell only 19.1 inches. The mean quantity of rain that has been observed to fall in the county of Rutland, in the course of the year, is 20.4 inches. At Selbourne, in Hampshire, where the country is rather hilly, the average quantity of rain which fell annually, between 1780 and 1786, was 36.08 inches.

Perhaps no circumstance more evidently and strongly proves the variability of our climate, with respect to rain, than the following facts, detailed by Dr. Hexton, concerning the quantity of rain which fell in certain years in Devonshire. There can be no doubt, that in this county, the climate is not only much moister, but the actual quantity of rain that falls is much greater, than in the south and south-eastern counties: and yet he informs us, that in 1751, the rain which fell measured only 17 inches, and 266.10ths; in 1711, 20 inches and 34.10ths; and in 1748, 20 inches and 903.10ths.

It appears, from a meteorological journal kept by Major Rooke, that the quantity of rain which fell at the four following places in the year 1798, was as follows: London, 23.22 inches; West Bridgford, Nottinghamshire, 27.22; Lancaster, 48.19; Kendal, 60.85. A farther comparison of the quantities of rain which fall at these places may be made by the following tables, given by Mr. Howe in his Agricultural Survey of the County of Nottingham: In 1793, there fell at London, 23.32 inches; at West Bridgford, 26.27; at Lancaster, 50.81; and at Kendal, 69.65. In 1794, at London, 18.15; at West Bridgford, 24.64; at Lancaster, 48.93; and at Kendal, 57.98. In 1795, at London, 17.86; at West Bridgford, 18.16; at Lancaster, 37.4; and at Kendal, 45.24. The fall of rain this year at Hull, was 22.98. In the year 1805, there fell at London 15.12 inches, while at Bremo the quantity was 26.25. The average gauge of rain at Sheffield is 33 inches in a year, which is about a medium between what falls in Lancashire and on the eastern coast. At Langrove, in Shropshire, a register was kept of the dry and wet days for the years 1796, 1797, 1798, 1799, 1800, and 1801; the result of which is, that in 1796, there were 201 dry days, and 164 wet; in 1797, 184 dry, and 181 wet; in 1798, the same; in 1799, 148 dry, and 217 wet; in 1800, 161 dry, and 204 wet; and in 1801, 163 dry, and 202 wet. In Staffordshire, the annual rains generally exceed 36 inches; whereas, in Worcestershire, under the same meridian of longitude, they fall short of 30—a proof of what was remarked, that those northern counties which lie as far to the west as the southern counties, in general have a moister climate.

In 1796, the fall of rain at Chertsey, in Surrey, was 25 inches; at London, 27; at Dinton, in Norfolk, 25; at Chatsworth, in Derbyshire, 30; at Horncastle, in Lincolnshire, 26; at Nottingham, 25; at Hull, 30; at Lancashire, 40; at Dalton, in Lancaster, 49; and at Kendal, 53 inches.

From the observations on the quantity of rain which fell at Liverpool, for a period of 18 years, beginning with the year 1775, made by Mr. Hutchinson, dockmaster at that place, it appears, that the mean annual quantity of rain which falls at that place, is 34.4168 inches; and that the mean falls of rain in each month, and each season of the year, on an average of the same period, were as follows: February, 1.5471; March, 1.5277; April, 2.1041; mean fall in the spring, 5.4730; May, 2.5729; June, 2.8159; July, 3.5628; mean fall in summer, 9.056; August, 3.3106; September, 3.6344; October, 3.7239; mean fall in autumn, 10.0839; November, 3.4408; December, 3.2876; January, 2.1741; mean fall in winter, 8.9025. At Dover, the mean annual fall is 37.82 inches; at Garsdale, which is a narrow valley, 13 miles to the north-east of Kendal, the quantity of rain that fell in the year 1777 was 49.5200 inches, and the number of rainy days 222. In the year 1778, the quantity of rain was 61.3660 inches; and the number of rainy days 249; and in the year 1779, the quantity of rain was 45.5999 inches, and the number of rainy days 197.

The comparative wetness of the climate in the north-west of England, will further appear from the following results of an account of the quantity of rain which fell at Manchester during eight years, from 1786 to 1793, both inclusive. In 1786, the number of days on which rain or snow fell, was 207, and the quantity of rain 40.5; in 1787, there were 290 rainy or snowy days, and the quantity of rain 47.5; in the year 1788, rain or snow fell on 178 days, and the quantity of rain was 27.15; in 1789, there were 206 days on which rain or snow fell, and the quantity of rain was 51 inches; in 1790, there were 210 of such days, and the rain amounted to 42.75 inches; in 1791, rain or snow fell on 223 days, and the quantity of rain was 64 inches; in 1792, there were 245 days of rain or snow, and the quantity of rain was 35.25 inches; and in the year 1793,...
1793, rain or snow fell on 233 days, and the quantity of rain amounted to 36.5 inches.

The midland counties in England receive, as might be expected, nearly the medium quantity of rain that falls on the western and eastern coasts; or rather, perhaps, the quantity that falls in them approaches nearer to the quantity that falls on the eastern than the western coast. Even in Derbyshire, though a mountainous district, much less rain falls than in Lancashire, or even Staffordshire or Shropshire, as will be evident from the following result, from a state of the falls of rain at Chatsworth, in Derbyshire, for the years 1777, 1778, 1779, 1780, 1781, 1792, and 1793. The average for the annual falls of these seven years, is 27,380 inches; the average falls in each month, classed according to the seasons, is as follows: In February, 1.673 inches; in March, 1.826; in April, 2.725—mean fall in spring, 5.667;—in the month of May, 2.285; in June, 1.944; in July, 2.734—mean fall in summer, 6.695;—in August, 2.033; in September, 3.173; in October, 3.288—mean fall in autumn, 8.944;—in November, 2.183; in December, 2.175; in January, 1.833—mean fall in winter, 6.211. From this account, it will be seen, that in this part of Derbyshire, at least, more rain falls in the autumn quarter than in any other quarter of the year, and less in the spring quarter; while the rain that falls in the summer and winter quarters, is nearly equal in quantity. By referring back to the account which has been given of the mean fall of rains at Liverpool for each season, it will be found that the same is the case there. This remark, as far as it applies to Derbyshire, is confirmed by the result of an account of the quantity of rain that fell at Chatsworth during a subsequent period of seven years, commencing with the year 1784;—the average for the whole period of 14 years, during each season of the year, being as follows: Spring, 4.989; summer, 7.547; autumn, 8.181; and winter, 6.686. It has also been remarked, that as we proceed northward, along the western coast, the quantity of rain which falls annually increases. Thus, the mean annual quantity of rain which falls in Liverpool, has been ascertained to be 34.41 inches; whereas, at Lancaster, from an account of the rain that fell there, during the years 1784, 1785, 1786, 1787, 1788, 1789, and 1790, kept by Dr Campbell, it appears that the mean annual fall amounts to 40.3 inches. At this place, also, the greatest quantity of rain falls during the autumn months, or more strictly speaking, during the months of July, August, and September; which circumstance, when we come to the consideration of the most prevalent winds in different parts of the kingdom, will be satisfactorily accounted for.

The counties in the vicinity of the metropolis are subject to comparatively trifling falls of rain. There are not data sufficiently accurate, and the result of observations continued for a sufficient length of time, to prove this so decisively as could be wished; but the following details of the annual quantity of rain at Youngsbury, near Ware, in Hertfordshire, 20 miles from London, which fell during five years, may be admitted as sufficient evidence, at least as respects that county; and the inference is fair, that unless there are local peculiarities in the adjoining counties, the quantity of rain will be ascertained to be nearly similar. In 1787, there fell 23.664 inches; in 1788, 28.567 inches; in 1789, 29.493; in 1790, 22.970; and in 1791, 24.260. From these details, a tolerably accurate idea of this branch of the meteorology of England may be formed. In those parts of the north-western counties, which lie among the mountains, the greatest quantity of rain falls, as about Kendal, where the annual average is upwards of 40 inches; and even where the situation is not mountainous, the north-western counties are exposed to great falls of rain; as we advance on this side of England to the south, the quantity of rain diminishes, though it is probable, that in the mountainous parts of Wales, and in the peninsula of Cornwall, and the west of Devonshire, this observation will by no means hold good. In the north-eastern counties of England more rain falls than in the south-eastern; but much less than in the north-western counties. Perhaps the county in which the least quantity of rain falls is Norfolk. From the account already given of the quantity of rain at Dover, it would appear to be very large; but the account was kept for too short a period to justify any positive and general inference.

With respect to the seasons of the year, when the greatest quantity of rain falls in different parts of the kingdom, it would seem that in the western counties, the autumn months, or rather the months of July, August, September, and October, are most exposed to rain; whereas on the eastern side of the kingdom, the winter months, that is, November, December, and January, are the wettest. From the greater prevalence of east winds, during the spring, on the east coast than on the west coast, it often happens, that at this season the eastern counties have heavier falls of rain than the western counties are liable to.

There are certainly not sufficient data on which to ground any statement of the annual average quantity of rain that falls in England at large. Dr Halley supposes it to be 22 inches; but this is evidently very greatly below the average. Mr Dalton, with much greater probability, fixes it at 31.3 inches. This result is drawn from what Mr Dalton conceives to be the largest collection of accounts of rain fallen in different places in England, that had appeared previously to the publication of his paper on the subject, in the Manchester Transactions for 1798. The average of these accounts is indeed 35.2 inches; but as the details contain no account of rain in Wales, though they contain an account of the rain in a much greater proportion of maritime than inland counties, and as it may be presumed, that the rain in Wales would exceed the mean given, as much as the inland counties, not contained in the list, from which he drew his mean, would fall short of it, he concludes, that in stating the average of England and Wales to be 31.3, he approximates as nearly as possible to the truth.

In order that the relative quantity of rain, which falls in the inland and maritime counties of England, may be more clearly and satisfactorily ascertained and compared, the following tabular view is subjoined, with the number of years annexed to each place, during which the observations were made:

<table>
<thead>
<tr>
<th>Counties Maritime.</th>
<th>Places.</th>
<th>Mean annual depth.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumberland.</td>
<td>Keswick, 7 years</td>
<td>67.5</td>
</tr>
<tr>
<td></td>
<td>Carlisle, 1 year</td>
<td>20.2</td>
</tr>
<tr>
<td>Westmoreland.</td>
<td>Kendal, 11 years</td>
<td>59.8</td>
</tr>
<tr>
<td></td>
<td>Fellfoot, 3 years</td>
<td>53.7</td>
</tr>
<tr>
<td></td>
<td>Wath Sutton, 5 years</td>
<td>40</td>
</tr>
<tr>
<td>Lancashire.</td>
<td>Lancaster, 10 years</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Liverpool, 18 years</td>
<td>34.4</td>
</tr>
<tr>
<td></td>
<td>Manchester, 9 years</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Townley, 15 years</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Crawshawbooth, near Haslingden, 2 years</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Dalton, 1 year</td>
<td>49</td>
</tr>
</tbody>
</table>

Tabular comparison of rain in maritime and inland counties.

Statistics.
The observations of attentive meteorologists have ascertained, that in this country it generally rains less in March than in November, in proportion, on an average, of 7 to 12; less in April than in October, in the proportion of 1 to 2; and less in May than in September, at least the chances for this are as 4 to 3.

The nature of the climate of England, with regard to moisture, cannot, however, be accurately determined, unless the quantity of dew that falls annually be also ascertained. On this point there are few observations or experiments of sufficient accuracy and duration to be relied upon. Dr Hales thinks, that the quantity of dew that falls on moist earth in this country is 0.28 inches; but Mr Dalton justly remarks, that this quantity is too small, as the dew which is deposited on grass is much more copious than what falls on moist earth. Hence, he is disposed to take the dew at 5 inches annually, and thus to reckon that 30 inches of water is deposited, at a medium, annually on the surface of the earth in England and Wales, reckoning 51 for rain, and 5 for dew, which is equal to 28 cubic miles, or 115 thousand millions of tons in weight nearly.

Evaporation. 

Closely connected with this branch of the meteorology of England and Wales, is that which regards the evaporation, which takes place from the surface of the ground. As it is evident, that all the water which falls in the form of rain or dew, must either be carried into the sea by some river, or be raised in vapour, Mr Dal-
Statistics.

At Liverpool.

It appears, from an account kept by Mr. Hutchinson at Liverpool, for 25 years, from 1708 to 1785, that the mean heat at that place, at 12 o'clock, is 53° of Fahrenheit's thermometer; the greatest degree of heat during that period, 86°; the least, 22°. The greatest range 64°; and the mean annual range 46°. The mean height of the thermometer, during the month of February, for the period, was 41°.3, of March 47°, of April 44°, of the spring season 48°; of the month of May 58°, of June 65°, of July 65°, the mean heat of summer 62°; of August 65°, September 61°, October 54°, the mean heat of autumn 60°; of November 47°, December 49°, and January 41°, and the mean heat of winter 44°.

The mean heat at Dover is 53°. The greatest degree of heat noticed during the years 1790, 1791, 1792, and 1793, 86°; the least 16°; the greatest range 70°; and the mean annual range 51° nearly. As, however, the observations on which these results are founded, were not complete during the whole of the years to which they relate, it is probable that the temperature of Dover is not accurately given, as it would then not be greater than the mean annual heat at Liverpool.

In Cheshire.

From accounts kept at Middlewich in Cheshire, with a thermometer in a room where there were no fires, at 10 o'clock in the morning, during the years 1768, 1769, 1770, 1771, and 1772, it appears that the mean heat at this place is 52°; the greatest heat 78°; the least 21°; the greatest range 57°; and the mean annual range 49°. In the month of February, the mean height was 46°, in March 48°, in April 50°, and in the spring the mean heat was 44°; in the month of May 60°, in June 63°, in July 68°, giving as the average heat of the summer 64°; in August 64°; in September 60°; in October 59°, the mean heat of autumn being thus 60°; in November 45°, December 42°, January 37°, giving as the mean heat of winter 43°.

At Kendal.

At Kendal, in Westmoreland, it was ascertained, from the observations of five years, beginning July 1787, that the mean temperature there, was 46°58. In winter, during wet weather, the mean height of the thermometer was nearly 40°; and in the same kind of weather during the summer, it was about 54°.

Lancaster.

The mean height of the thermometer at Lancaster during seven years, viz. 1784, 1785, 1786, 1787, 1788, 1789, and 1790, was 51°8 at two o'clock in the afternoon; 45°6 at 10 o'clock at night. The mean heat, noon and night, 48°7; the highest degree 82; and the lowest 18°. The mean heat of January 59°1, of February 41°3, of March 41°6, April 50°, May 59°3, June 64°5, July 64°1, August 68°2, September 59°4, October 52°1, November 45°5, and December 39°2, at two o'clock in the afternoon.

London.

At London, by a mean of the observations made at the Royal Society from 1772 to 1786, it appears that the mean annual temperature is 51°9; and the monthly temperature as follows, January 55°9, February 42°3, March 46°4, April 49°5, May 56°6, June 63°22, July 66°8, August 65°8, September 59°83, October 52°81, November 44°44, and December 41°04. The greatest usual cold is 20°, and occurs in January; the greatest usual heat is 81°, and happens generally in July. The limits of the annual variation are 25.5, that is, 1° above and 1°.5 below the mean. The greatest variations of the mean temperature of the same month in different years, are as follows, January 6°, February 5°, March 4°, April 3°, May 2.5°, June 2°, July 2°, August 2°, September 3°, October 4°, November 5°, December 3°. From this statement it will be seen, that the temperature of the summers differs much less than that of the winters. The most common variations of temperature in London, and its vicinity, within the space of 24 hours in every month, are January 6°, February 8°, March 20°, April 18°, May 14°, June 12°, July 10°, August 15°, September 18°, October 14°, November 9°, December 6°.

From observations made at York, which, however, were confined to one year, it appears, that the mean annual temperature in that city is 49°. The medium heat of each month and season, deduced from the same observations, is as follows: February 35°, March 43°, April 50°, giving as the medium heat of the spring 42°3; of May 59°, June 63°, July 68°, giving as the medium temperature of the summer season 63°; of August 65°, September 56°, October 48°, giving as the medium temperature of the autumn months 59°4; of November 40°, December 35°, January 33°, giving as the medium temperature of the winter season 36°.

From the observations made with two thermometers at the same time, one near Cullumpton in Devonshire, and the other at Yoxhelly in Staffordshire, it was ascertained that the heat in the former county above that in the latter, was, on one day, as follows: November 1794, 5°, December 4°, January 1795, 8°47, February 6°3, March 6°3, April 10°, May 8°7, June 8°3. The thermometer in Devonshire was observed at 8°47, at 11 A. M., and there was frequently a variation of one, two, three, and four degrees, and sometimes even five and seven degrees in that space of time, the thermometer generally standing higher at the latter hours, but sometimes lower. From the observations made by Dr. Babington, with a thermometer at Ludlow in Shropshire, it was ascertained, that on an average of 53 days, the heat was not quite one-eighth of a degree greater than at Yoxhelly in Staffordshire.

The comparative temperature of different parts of England will be further illustrated by the following facts: Dr. Thomas Young remarks, that the mean temperature of the six winter months, from October to March, at London, is 43°5; while at Dawlish, on the south coast of Devonshire, it is 43°3; and at Ilfracombe, on the Bristol Channel, it is so high as 59°. From November to March, the mean temperature of London is 42°6; of Penzance, in Cornwall, 48°1. From January to March, at London, 57°9; at Penzance, 48°3; and at Sidmouth, in Devonshire, 41°7. During February and March, at London, 41°5; and at Clifton, 42°5. From October to December, at London, 47°; and at Sidmouth, 45°7. From December to February, the mean temperature at London is 59°7. In the most sheltered parts of Devonshire, during winter, the temperature is 1.5 above that of London. In the coldest months, at Penzance, the temperature is 4.5 higher than at London.

From observations made the same year at Sidmouth and Derby, the following result is given:

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Sidmouth</th>
<th>Derby</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest degree</td>
<td>76</td>
<td>78</td>
</tr>
<tr>
<td>Lowest</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>Greatest variation</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Mean for the day</td>
<td>55</td>
<td>60</td>
</tr>
<tr>
<td>Mean for the night</td>
<td>39</td>
<td>37</td>
</tr>
<tr>
<td>Annual mean</td>
<td>47</td>
<td>43</td>
</tr>
</tbody>
</table>
The mean at Nottingham, for four years, was 48°. 75. The mean heat of the month of March, at two o'clock in the afternoon, in Pall Mall, according to Dr Heberden, is 50°. At Lancaster, the mean heat of the same month, at the same hour, is only 41°. 4.

It must not, however, be inferred from these details, that the cold in winter, and the heat in summer, is never very extreme in England; for the climate of this country varies nearly as much with respect to temperature, as it does with respect to rain. It occasionally happens, that very great degrees of cold are felt during the winter months, especially towards the end of December and the beginning of January; in some years the thermometer, without being exposed to the action of any circumstances, which would bring down the mercury to an inferior level, has indicated a degree of cold, not often felt even in countries lying much farther to the north, and not enjoying such a near vicinity to the sea as England does. It is said, that in the years 1794, 1798, and 1813-14, the thermometer was observed to be as low as within five degrees of zero; and from observations carefully made at different places, there can be no doubt, that in the last of these years, it was within eight degrees of zero. The heat, on the contrary, is sometimes very excessive, especially in the southern counties of England. In 1808, the thermometer, at many places in the vicinity of the metropolis, was nearly 90°, if it did not quite reach that point. It may also be remarked, that in the southern and south-western districts, in the months of April, May, and June, if there are a few days, or even hours, of bright unclouded sun, the thermometer will rise as high as in the south of France, or even as high as in Italy. These gleams, however, are often succeeded by frosty or very cold nights; and probably the next day or two, it is followed by hail or cold cloudy weather. In the summer months, even when the heat has been for a considerable time very great, the thermometer is observed to stand low an hour or two before sunrise; and much lower, at this time of the morning, in April, May, and June, than in July, August, and September.

The third branch of the meteorology of England, respects the winds. It has already been remarked, in the general observations on the climate of this country, that the west and south-west are much more prevalent, as well as constant, than the winds from any other quarter; and this circumstance may easily and naturally be accounted for, from the situation of the island, exposed to the Atlantic Ocean. The west and south-west winds are also the most violent, not only on the western side of the country, but likewise in the midland and eastern counties; so much so, indeed, that the effects of their constancy and violence may generally be traced, in the evident bending which they have given to the trees in all parts of the country. The winds that blow from the east and north-east are, next to those that blow from the west and south-west, the most regular and constant, and perhaps next to them the most violent; though it may be remarked, that in England the east and north-east winds seldom blow violently for more than one or two days, whereas the west and south-west winds frequently continue to blow violently for a considerably longer time. The wind that most seldom occurs, is that from the south. In some parts of the island, particularly in the western counties, the south-eastern winds are not uncommon. The north-western winds do not blow for any considerable part of the year, but when they do blow, they are generally steady.

In the summer time, it frequently happens that the wind veers round to several different quarters in the course of the day, or even in the course of a few hours; but this is never observed to be the case when it blows with the least violence. Near the sea coast, and even at the distance of several miles from it, during settled and warm weather, in the summer season, the wind at the break of day will blow from the land; about mid-day, or a little before it, it will veer round towards the sea; and in the course of the evening it will again become a land wind. Sometimes we are subject, in England, to a wind that in some respects resembles the sirocco wind of Sicily, though the variation in temperature, with us, is not nearly so considerable. It sometimes happens towards the end of April, but more frequently in May, the medium height of the thermometer being about 45°, with variable winds: The barometer falls, and the wind then becomes stationary at south-west, or south, blowing briskly: The thermometer then rises to 50°, 60°, or even 65°, and the heat of the air has an oppressive feel. When this wind ceases, it is generally followed by a wind from the opposite point of the compass, i.e., north-east, and the temperature soon lowers again to 45°. With respect to the connection of the height of the mercury in the barometer, with the different winds which prevail in England, it may be remarked, (and the remark will apply, in a greater or less degree to all parts of the island,) that the barometer is always higher and more steady when the wind blows from the north, or east, or from any point between these two quarters, than when it blows from the south, or west, or from any point between these two quarters; so that it generally happens, that rain falls when the barometer, with an easterly or north-easterly wind, is at a height, which, with a west-erly or south-westerly wind, would certainly indicate settled fair weather. In the eastern counties of England, when the winds from the east and north-east blow with the most constancy, and for the greatest length of time, they are often accompanied, especially in the months of April and May, with a blue mist and vaporous atmosphere.

From the observations made by order of the Royal Society, it was ascertained, that, at London, the state of the wind was as follows: The south-west winds blew 112 days; the south-east, 32 days; the north-east, 68 days; the east, 26 days; the north-west, 50 days; the south, 18 days; the west, 53 days; and the north, 16 days. From the same register it appears, that, in the vicinity of the metropolis, the south-west wind blows more upon an average in each month of the year than any other, particularly in July and August; that the north-east prevails during the months of January, March, April, May, and June, and is least common in February, July, September, and December; and that north-west winds occur most frequently from November to March, and less so in September and October, than in any other months.

From other observations made in this part of the island, it has been ascertained, that winds blowing from every point of the compass between the west, north-west, and north, are so very dry as not to produce a day's rain in the year. It sometimes, however, happens, that with a north-west wind small rain falls for a few hours. When the wind veers from the north through the west, it generally continues dry till it reaches the south-west, when it certainly brings rain. On the other hand, when it passes southward through...
The eastern points, the weather is perfectly dry till it reaches about the south-east. These observations apply, with different degrees of accuracy, to the climate not only in the immediate vicinity of the metropolis, but also to most of the counties in the south and south-east of England.

At Liverpool, Mr. Hutchinson made very minute and careful observations, not only on the direction, but also on the velocity of the winds prevalent in that part of the island. His mode of ascertaining the relative velocity, though not, perhaps, perfectly satisfactory, is yet sufficiently so for our purpose. The following is the result of his labours, containing the annual mean, deduced from 25 years' observations: The north wind blew 13 days; its mean velocity is expressed by 8: the north-east wind blew 29 days; its mean velocity is also expressed by 8: the easterly wind prevailed 18 days, with a velocity expressed by 9: the south-east wind blew 115 days, with a velocity equal to 8: the south wind blew 9 days, with a velocity expressed by 7: the south-west blew 54 days, with the velocity of 12: the west blew 49 days, with the greatest velocity of all the winds, being expressed by 13: and the north-west wind blew 58 days, with a velocity equal to 10.

If we take the north and east winds in opposition to the south and west, they will stand as follows:

<table>
<thead>
<tr>
<th>Days</th>
<th>Mean Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>13</td>
</tr>
<tr>
<td>North-east</td>
<td>29</td>
</tr>
<tr>
<td>East</td>
<td>18</td>
</tr>
<tr>
<td>South-east</td>
<td>115</td>
</tr>
</tbody>
</table>

Total of the N. E. winds = 175, Mean velocity of N. E. winds = 8.3

South = 9, South-west = 54, West = 49, North-west = 58

Total of the S. W. winds = 170, Mean velocity of S. W. winds = 10.1

From these results it appears, that at Liverpool the wind blows more frequently from the south-east than from any other point; and this circumstance, at first sight, may be deemed to contradict the general observations which we affirmed on the most prevalent winds in England; but Dr. Darwin, as well as Dr. Garnett, very satisfactorily ascribe this remarkable deviation at Liverpool to some atmospheric eddy, produced by the situation of the place.

At Dover, upon an average of three years, it was ascertained, that the winds at Dover have blown as follows: North, 27 days; north-east, 118; east, 13; south-east, 37; south, 8; south-west, 195; west, 35; north-west, 91. If we take the north and east in opposition to the south and west, they will stand as follows:

<table>
<thead>
<tr>
<th>Days</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>South</td>
</tr>
<tr>
<td>North-east</td>
<td>South-west</td>
</tr>
<tr>
<td>East</td>
<td>West</td>
</tr>
<tr>
<td>South-east</td>
<td>North-west</td>
</tr>
</tbody>
</table>

Total of the north-easterly winds = 200, Total of the south-westerly winds = 329

The results of these observations, made at Dover, will confirm the remark of Drs. Darwin and Garnett, that the great prevalence of south-easterly winds at Liverpool is owing to some local cause. This will be still further confirmed and illustrated by the following result of Dr. Campbell's observations at Lancaster; where, upon an average of seven years, the winds were observed to blow in the following directions: North, 30 days; north-east, 67 days; north-west, 26 days; south, 51 days; south-east, 35, south-west 92, east, 17, west, 47.

Taking the north and east winds in opposition to the south and west, they stand as follows:

<table>
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<tr>
<th>Days</th>
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<tr>
<td>North</td>
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<td>North-east</td>
<td>South-west</td>
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Taking the north and east winds in opposition to the south and west, they stand as follows:

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<td>South-east</td>
<td>North-west</td>
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<td>East</td>
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At Sidmouth, in Devonshire, the result of 406 observations on the winds was as follows:

<table>
<thead>
<tr>
<th>Wind</th>
<th>Times</th>
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</thead>
<tbody>
<tr>
<td>North</td>
<td>54</td>
<td>South</td>
<td>42</td>
</tr>
<tr>
<td>North-east</td>
<td>40</td>
<td>South-west</td>
<td>95</td>
</tr>
<tr>
<td>East</td>
<td>13</td>
<td>West</td>
<td>38</td>
</tr>
<tr>
<td>South-east</td>
<td>58</td>
<td>North-west</td>
<td>66</td>
</tr>
</tbody>
</table>

At Derby, from 366 observations, it appeared that the north and north-east winds blew 85 times, the east and south-east 56, the south and south-west 119, and the west and north-west 106.

The observations which have been made in the direction and velocity of the winds in this island, are, however, too few—have been continued for too short a time—and not made in a sufficient variety of places, to justify any very particular conclusion on the subject. From these causes, it happens, that the statements and opinions of meteorologists, on this branch of the meteorology of England, differ so much. According to a meteorological register kept by Major Rooke for sixteen years, from 1785 to 1800 inclusive, the most frequent winds in England blow from the south-west and north-west; and, during the last eight years of this period, the south-west winds were observed to be more prevalent, and those from other quarters to be less so; while the average number of days in which the north-east wind prevailed, appears to have been much the same during both periods. This statement, as far as it regards the prevalence of the north-west winds, is certainly at variance with the observations of all other meteorologists; since the wind from this quarter more seldom occurs in all parts of England than that from any other quarter, with the exception of the south and the east in some parts of the island.

The meteorology of any country must be considerably illustrated by the state of the barometer in it at different periods of the year; we shall therefore give the results of observations on this instrument in different parts of England.

At Liverpool, for twenty-five years, it was ascertained, that the mean height of the barometer was 29.74 inches; the greatest height during that period 30.90, the least 28.6; the greatest range 2.89, and the annual average range 1.96. The mean height in each month was as follows:

January 29.71, February 29.58, March 29.80, April 29.78, May 29.80, June 29.82, July 29.82, August 29.82.
ENGLAND.

29.51, September 29.69, October 29.71, November 29.64, December 29.64. From this statement it is evident, that the mean height of the barometer in this part of the island is greater during the months of May, June, July, and August, than in any other four months. The barometer at Dover was observed by Mr Manton, surgeon at that place, during the years 1789, 1790, 1791, 1792, and till September 1793. From his observations, it was found that the mean height of this instrument, on an average of these five years, was 29.90 inches; the greatest height during that period 30.93; the least 28.49; the greatest range 2.47; and the mean annual range 1.50.

Mr Vernon kept a journal of the height of the barometer at Middlewich in Cheshire for five years, from 1768 to 1772, both inclusive, and he found the greatest height to be 31; the least 28; the greatest range 3; and the mean annual range 1.94.

At Kendal, the mean height of the barometer at Kendal, collected from the observations of five years, beginning July 1787, was 29.7345. In 1787, it was found to be 29.810, and in 1794, 29.793. The greatest height of the barometer at Keswick, during the year 1793, was 30.38; the least height 28.33; the mean height 29.55; the greatest range 1.05; the mean monthly range 1.11. According to Mr Dalton, the mean annual height at this place is 29.79.

The mean annual height of the barometer at York, on an average of four years, was found to be 29.70; the greatest height during the year 1774, was 30.75; the least 28.60; the greatest range 2.15, and the mean range 0.31. The mean of the months from October to March inclusive, was 1.42, and in the six summer months, only 1.016.

The mean height of the barometer in London, upon an average of two observations in every day, kept at the house of the Royal Society, for many years, was found to be 29.88. According to Mr Kirwan, the usual variation of the barometer in England is two inches and a half.

At Sidmouth, an attentive observation of the barometer for one year, gave the following results: Highest, December 29th, 30.61; wind north-east. Lowest, October 19, 28.81; wind south-west. Greatest range, March 3, 4, 0.98; annual mean 29.93. The same year at Derby; highest, December 7, 30.48; wind north-east. Lowest, October 19, 28.34; wind south. The greatest range was observed in February, and was 0.65; annual mean, 29.74.

Thunder and lightning are not very common in England, though it seldom happens that the summer passes over without their occurring. They are very rare after the month of September, and scarcely ever occur between December and May; it is in the months of May, June, July, August, and September, particularly the two last, that we usually expect thunder storms of any consequence or duration. It seems to be ascertained, that in this island, the frequency of thunder and lightning is in proportion to the temperature of the air. There are few observations on this subject, but the following extract from Dalton's Meteorology, pages 29 and 46, will bear out this assertion.

It seldom happens that storms of thunder and lightning in England are very fatal; and it has not been observed, that when they are fatal, the mischief which they do, is greater in the southern than in the northern counties.

The aurora borealis is neither very common nor very brilliant in the southern parts of the island; but in the northern counties it is frequent, and its coruscations very bright and beautiful. It seems to be ascertained, that it was very rare in any part of the island, previous to the commencement of the 18th century; and since 1793, it has seldom appeared. The only particular observations on this part of the meteorology of England that we possess, are supplied by Mr Dalton, and they refer to Westmoreland, where they were made; this philosopher found, that in 1786, the number of the aurora borealis was 16: in 1787, 27; in 1788, 53; in 1789, 43; in 1790, 36; in 1791, 37; and in 1792, 28. In the month of January, on an average of three years, the number was 18; in February, 15; in March, 26; in April, 32; in May, 21; in June, 5; in July, 2; in August, 21; in September, 25; in October, 36; in November, 38; and in December, 9. When Mr Dalton removed from Kendal to Manchester, he continued to make his observations on this phenomenon; and the result confirms the remark we have made, that since 1793, it has seldom occurred in this island; for in 1794, he observed only 6, in January, March, and December; in 1795, only 2, both in September; in the year 1796, none were observed; in 1797, 12; in 1798, none; in 1799, 2; in 1800, 4; in 1801, 4; so that, during this period of eight years, only 32 were observed, whereas during the period of seven years, from 1786 to 1792, the number was 237.

CHAP. IV.

Soils.

The soils of England are so various, that it is impossible to give any general account of them; and in marks most parts of the kingdom, they pass so frequently and suddenly from one kind to another, that it would be tedious, and far exceed the limits of this article, even if the minute and extensive knowledge necessary for such an undertaking were possessed, to describe them all, in different districts. We shall, however, endeavour to give the reader such an idea of them as will enable him to comprehend their leading features, and to become acquainted with the most prevalent and extensive soils in the different districts of England. They may be classed under the following heads: clay, loam, sand, chalk, gravel, and peat; of the first description there are two kinds; deep, dark-coloured, rich clay; and clay of a less fertile quality, of a pale colour, and of comparatively small depth. The latter is by far the most prevalent in England. Of loams, there are several varieties: strong loam, which in general has been formed of clay, long under a course of tillage, and consequently much exposed to the action of the sun and air; loam of a less tenacious nature; calcareous loam, and sandy loam; the last, like the first description of loam, is rather an artificial soil, formed of sand, en-
ENGLAND.

The soils of England, in many parts, though cool, is deep, and lies on an absorbent substratum. A small patch of the red soil, which has already been noticed as stretching from Nottinghamshire to the western counties, is met with in Lancashire, between Eccleston and Preston. The sandy lands lie principally between the Ribble and the Mersey, reaching westward to the eastward nearly to Manchester. The most common subsoil is a red sand rock. The eastern part of the county in general consists of a cold retentive soil.

The soil of the North Riding of Yorkshire, along the coast, consists of brownish clay and loam; in many places coldly calcareous, partly from its nature, and partly from the exposed situation of the ground. Cleveland consists generally of a fertile clay, and of a red sandy soil. The vale of York consists of various soils; the upper parts are occupied by cool strong lands: in the eastern quarter, weak sandy heathlands are found; but, in general, the soil of the vale is a rich dry loam: the western part of this Riding is occupied by moorlands: though, in many of the dales, the soil is sharp and fertile. In the West Riding, the arable soils may be considered as comprehending all the varieties which prevail in Britain, but the prevailing description is loam; limestone land is also met with; and near the Ouse, strong tenacious clay: the western division of this Riding contains extensive moorlands. The wolds occupy a large part of the East Riding; the soil on them is calcareous, with a mixture of gravel: the district of Holderness, which occupies the other part of this Riding, consists, for the most part, of a strong loamy soil. The most prevalent soil in Westmoreland is a dry gravelly mould: in the east and north, sand and hazel mould are found; the subsoil in these districts is calcareous: towards the Eden and eastern mountains, clay is found: the tops of the mountains are in general covered with a dry soil, upon a hard blue rock.

In the district of England which borders on Wales, there is less diversity of soil than in the northern district. The county of Chester consists almost entirely of two descriptions of soil; sand, generally of a rich quality, lying on a substratum of red grit rock; and strong loam; the latter in some places is rather moist and retentive, but on the whole may be regarded as a valuable and useful soil; heaths are found intermixed with the loamy soil, but not to any considerable extent. The sandy soil unites with that of the same description in Lancashire, already noticed. In Shropshire there is nearly an equal quantity of strong and light soils; the former, however, is supposed rather to predominate: on the north-east of the Severn, the soil is light and dry; on the south-west of that river, as low as Cressage, and for eight miles down, a very great variety, and rapid succession of soils, occur: from this place, nearly to Ludlow, the soil, in general, is thin, and rather cold: the remainder of the county, especially on the south-west side of it, is mostly thin soil, some upon clay, some upon rock; upon the whole, there is in Shropshire nearly all descriptions of soil, except chalk and flint. There are few counties, in any part of England, which present such a large proportion of valuable and fertile
soil as Herefordshire: in its general character, it is a mixture of marl and clay, in which, at least in some places, the calcareous earth is very evident and predominant. There is no appearance of chalk or flint; but the tenacity of the clay, besides being reduced and anemiculated by the calcareous soil, is farther divided and softened by sand. In some parts of the county, however, particularly towards the west borders, the clay soil is cold and ungenial; the substratum here is lignitic, of a dark jet black kind; towards the east of Herefordshire, the soil also varies from its general character, being loose and shallow, and not of very great fertility or value. In the centre of the county, especially round the city of Hereford, gravelly soil, to a considerable depth, is met with. On the south, there is some sand, naturally of rather a good quality, and much improved by manure and cultivation. The richest tract of the strong clay soil, extends from Hereford towards Ledbury. In the county of Monmouth, there is much variety of soil, but generally of a good quality, and rather dry and light than moist and heavy: from Rumney Bridge to Newport, loam is found resting on rock, rubble, or clay; in the vale part of this tract, the loam is lighter, much intermixed with mud, and very fertile. Along the coast, from the Usk to Portskewit, the soil is also a rich loam, intermixed with mud and sand, and of a brownish or grey colour: the substratum in many parts is limestone: the proper clay district of Monmouthshire lies in the hundred of Usk: this species of soil is also met with in Raglan hundred: in both these hundred, the clay is occasionally of a great depth, but where not so, it lies on a bed of rubble. Round the town of Monmouth, the soil is various, partly clay, partly gravelly sand; the substratum rubble: the red soil, already frequently mentioned as possessing great fertility, and as stretching from Nottinghamshire into the west of England, is met with in a few spots of the hundred of Abergavenny. On the whole, the county of Monmouth possesses a valuable and fertile soil.

The soil of many of the counties which compose the midland district of England, especially that of Nottinghamshire, Leicestershire, Rutlandshire, and Northamptonshire, is more uniform and similar than that of any district in England of an equal size. The prevalent soils in these counties may be characterised as loam of different degrees of depth, strength, and fertility; but generally rather strong, dry, and sound. Although, however, this description applies generally to the soils of this district of England, there are exceptions to it. In the county of Nottingham, sandy soil is found in the forest district; rich light loam, lying on sand or gravel, stretches along the banks of the Trent; and there are two tracts of land, which are denominated the north and south clays, though perhaps they might be more strictly and justly called strong loams. The Vale of Belvoir is one of the best and fairest specimens of the soil of this county, being a loam of great fertility. That description of country called Wouls, prevails in some parts. The soil on them is generally a cold clay. The subsoil in many parts of Nottinghamshire is limestone; in other parts, sand and gravel; and in other parts again, the soil continues of the same nature and quality for a considerable depth. In Leicestershire, no clay or sand, strictly so called, are to be met with; nor is there any moss or peaty soil, the peat bogs, by draining, cultivation, and manure, having been rendered valuable meadow soil. The soil of Leicestershire, therefore, may be divided into three kinds: strong loam, lighter loam, and loam nearly of an equal strength as the first kind, but of a moister nature. The first description in general is found in the valleys. The characteristic of the upland soil is a reddish friable loam, lying on gravel, rock, or marl. The third description of soil occurs near the banks of the rivers, or in those places where the peat bogs have been drained and cultivated. The prevalent soil of Rutlandshire may be conjectured from the etymology of the name of the county, *riddle*, in many parts of England, being the common appellation of that red clay or loam, with which sheepers mark their sheep. This kind of soil, of a strong nature, is found extensively in Rutlandshire, especially in the centre of the county, and towards the northern and western borders. The soil in the east and south-east parts is mostly shallow, upon a limestone rock. The upland parts of Northamptonshire generally consist either of a brown or a red loam, more or less tenacious. The subsoil in these parts, for the most part, is stone in loose fragments, or what is usually called rubble. This stone is evidently calcareous, though in many places it is not pure enough to be burnt into lime. Besides this subsoil, the brown or red loam, in other parts of the county, rests on gravel and clay. In the north-west of Northamptonshire, the soil is thin and light, though the subsoils are still for the most part calcareous. The east of the county consists of fens; and in the vicinity of these fens, as well as in the meadow lands, fertile deep soil is very prevalent. On the whole, the soil of this county may be described as consisting of rich loam, which seldom changes either into clay or sand. Of the other counties, which, in geographical arrangement of England, we placed in the midland district, the same observation respecting soil will not hold good, which we have affirmed respecting the counties just mentioned. Derbyshire, however, at least the southern part of it, may perhaps be excepted. The most common soil in this part of the county, resembles the red soil so frequently noticed; but it is intermixed with tracts of sand and gravel. On the north-west side of the county, limestone soil is found of different qualities and degrees of fertility. On the east side, clay, generally tenacious, cold, and unfertile, abounds. The same description of soil predominates in the north of Derbyshire. Here also peat and moor soil is very prevalent. In Staffordshire, the soils most commonly met with, are peat in the northern parts, and loams of various degrees of strength and fertility in the central and southern parts. In the neighbourhood of Lichfield, there is much excellent soil. The lands which border on the Trent are also uncommonly fertile.

There are few counties in any part of England that display more unequivocal proofs of fertility of soil, even to those who are not accurately acquainted with the method of distinguishing it, than Worcestershire. Though it varies in its kind, its quality is almost uniformly good. To the north of Worcester, it consists chiefly of rich loamy sand. In the eastern quarter of the county, the prevailing soil is, for the most part, a strong clay, but not cold or ungenial. To the south, between Worcester and the Vale of Evesham, red land and strong loamy clay are found. In the vale itself, the soil is remarkably deep and rich, consisting of a dark coloured earth, in some parts so strong as to be fit for making bricks; and in other places of a more friable nature. The subsoil here is either gravel or strong clay; light sandy soils and gravel prevail chiefly near Kidderminster and Steurbridge. It is generally supposed that one half of the county consists of rich clay and loamy soils, with a substratum of limestone. The soil of the Cotswold
hills, in Gloucestershire, consists generally of a calcareous loam, mixed with gravel and small stones, which, in this and some other counties of England, is provisionally denominated stone brash. The soil on the Stroudwater hills is principally a light loam lying on stone brash. The vale districts of Gloucestershire possess in general a very rich soil, varying from clay of rather a strong quality, to friable loam. In the vale of Evesham, the soil for the most part is of the latter description, though occasionally sand and gravel are met with. The vale of Berkeley is more uniform in the nature and quality of its soil. In the Forest of Dean, which is separated from the rest of the county by the river Severn, the soil is rather strong, and by no means unfertile. On the whole, Gloucestershire possesses a large proportion of rich and valuable soil, and may be reckoned, in this respect, among the most favoured in England. The soil of Warwickshire is not nearly so uniformly good as that of the county just described. In the northern part of this county, there is much barren and waste land, intermixed, however, with large tracts of strong soil. The central and smaller portion of the county, which is called the Fielden, possesses a great fertility. Oxfordshire contains three distinctions of soil; the red land of the northern district, which extends from the borders of Warwickshire and Northamptonshire, to the south of Doddington. This soil, like all the rest of the same description, is very fertile. The substratum is either grit-stone or limestone. The next division of soil is the stone-brash, which lies to the south of the red land, and stretches the whole breadth of the county, from the borders of Gloucestershire to those of Buckinghamshire. It is, however, very narrow on the borders of the latter county. The predominant feature in this extensive tract is that of a loose, dry, friable loam, mixed with limestone, and in general resting upon it. The third division consists of the Chiltern district, lying in the south-east of the county, and bordering on Buckinghamshire. The basis of this part of Oxfordshire is chalk, on which there is a surface of loam, of various depths, and of different degrees of fertility. The most distinguishing mark of the surface loam, is a very considerable quantity of flints. Nearly, however, one half of this county, occupying the centre and part of the southern division of it, includes all sorts of soils from loose sand to heavy clay. The soil of the county of Buckingham is composed chiefly of rich loam, strong clay, chalk, and loam incumbent on gravel, and mixed with it. In the southern parts of this county are the Chiltern hills, which are principally composed of chalk intermixed with flints, similar to the chalk and flints of the adjoining part of Oxfordshire. The soil on these hills is very shallow; the substratum is uniformly chalk. In the northern part of Buckinghamshire, the soil is of a very different quality, being composed of strong rich loam, occasionally mixed with loam of a more friable nature. The vale of Aylesbury occupies the centre of the county, and in richness of loamy soil, is not surpassed by any vale district in the kingdom. The south of Bedfordshire consists of calcareous hills; below which there is a cold, barren, clayey soil. In a line from the middle of the county to the south-east corner, the soil is generally rich, composed of strong loam. The west side is mostly flat and sandy. The sands about Woburn are almost proverbial for their depth. They are not, however, by any means unfertile. The vale of Bedford consists of a rich loam. On the north side of the vale a strong clay occurs. Towards the north and north-eastern parts of the county, the richest soil is met with, consisting of loam of uncommon depth. The substrata most common in this county are limestone, ferruginous sand, and clay.

Of the counties which, in our geographical arrangement of England, were classed under the eastern district, the soil is not very various: this remark more particularly and strictly applies to Lincolnshire, Huntingdonshire, Cambridgeshire, Norfolk, Suffolk, and Essex. In Hertfordshire and Middlesex, there is greater variety of soil. Lincolnshire consists of calcareous, sandy, and loamy soils; the first description is principally found on the heaths to the north and south of the county, and on the wolds; a large tract of sandy soil occurs between Gainsborough and Newark; the same kind of soil is found from Binbrook to Barton; at the latter place, the rich loam commences, which occupies an extensive tract. A loam of an equal, if not superior quality, is found in the island of Axholme. The marsh lands of Lincolnshire are in general composed of loam, though there are some spots of cold tenacious clay. The soils in the upland parts of Huntingdonshire are various, but they consist principally of strong deep clay loam or less in friable chalk loam mixed with loam, or of a deep gravelly soil, with loam. The marshes resemble those of Lincolnshire: the same may be said of the marshes of Norfolk and Cambridgeshire. The soil of the uplands in this last county, also resembles that of Huntingdonshire, only it presents a smaller proportion of strong loam; and calcareous loam, which does not occur in Huntingdonshire, is met with in Cambridgeshire: the substratum is chalk, gravel, or clay. It has already been remarked, that the soil of Norfolk is the most uniform of any in the kingdom; it is, in fact, sandy loam throughout the whole county, though in some parts there is a small proportion of clay; in no part of this county, however, can there justly be said to be clayey soil. It may also be regarded as the most artificial soil in the kingdom. The richest soil lies to the north and north-east of Norwich; this tract consists of a true sandy loam, equal and similar to the best parts of the Netherlands. To the west and north-west of Norwich, the soil is much lighter; and to the south-west of this city, the soil is so very light, that the sand is very often drifted in high winds from one parish to another. Suffolk may be considered as consisting principally of light sand, and of very strong loam, which is sometimes, though improperly, called clay. The border prevails chiefly on the sea-coast, and in the north-west part of the county; the latter occupies the centre of the county; the strongest loam is in that part called High Suffolk. In Essex, there is very little sandy soil, and none which can properly be called clay, but loams of all descriptions prevail: the richest are in the north and north-eastern parts of the county. About Saffron Walden, the loams are rich, dry, and very fertile. Near the banks of the Thames, and along the sea-coast, marshy land prevails. The soils in Hertfordshire consist of loam, clay, chalk, and gravel: the loams may be divided into flinty and sandy; in some places they are of a red colour. The flinty loam lies to the east of the county: the richest sandy loam is near Cheshunt. Chalk occupies the north-west corner, and a small spot in the south, on the borders of Middlesex. In the north-east, from Royston to King’s Walden, is a chalky soil; the gravel is a very poor soil, and prevails near North Mins. Chalk forms the basis of nearly the whole county. In Middlesex, the summits of most of the highest hills consist of sand and gravel. Sandy loam is found on all
that part of the county which lies between the road leading from Hounslow to Colnbrook, on the north, and the Thames on the south; the subsoil here consists of flints and gravel: loam, with a smaller proportion of sand, occurs to the west of Hounslow, and in the parishes of Chelsea, Kensington, &c. Near Harrow, Pinner, and South Mims, on the borders of Hertfordshire, the soil is a strong loam: this soil also prevails in the northern vicinity of the metropolis. Clay occurs in very few places: near Howden, the soil is of this description. From Rickmansworth to Staines, peaty earth, on flinty gravel, prevails; the Isle of Dogs, and most of the ground on the borders of the sea and Coln, consist of a rich mud.

Of the south-eastern district.

The counties which compose the south-eastern district, are similar in the general features of their soil. In Kent, the Isle of Thanet is calcareous: the Isle of Sheppey a strong clay. In East Kent, chalk, loam, and stiff clay, are found: rich sandy loam occurs on the south-coast near Sandwich and Deal. Romney Marsh consists of loam of great fertility. The Weald of Kent, Surrey, and Sussex, has already been mentioned, as containing the greatest extent of clay soil in the kingdom. The richest loam in this county is near Maidstone: the substratum, through nearly the whole of it, is calcareous. The South Downs in Sussex are calcareous; the centre and north are occupied by the Weald: the eastern side of the sea-coast consists of a strong soil, inclining to be wet. The western side, especially near Chichester, contains loam of uncommon depth, and which may justly be reckoned among the most fertile soils in the kingdom. Besides the Weald of Surrey, this county consists of very rich sandy loam, near Guil- ford; of deep calcareous loam between Croydon and Epsom; of chalk on the Downs; and of rich sandy loam about Battersea, Mortlake, Moulsey, &c. Heaths occupy the south-west part of Surrey.

The southern district of England is composed of Berkshire, Wiltshire, Hampshire, and Dorsetshire; in all of which counties, calcareous soils are very predominant. In Berkshire, the most remarkable division is the vale of the White Horse, which is bounded on one side by the Thames, and on the other by the White Horse hills; it extends from Buscot to Streatham: the soil of this vale is a strong grey calcareous loam, evidently formed by vegetable earth and chalk. In the vale of the Kennet, the prevailing soil is gravel: in the forest division, there is gravel, clay, and loam; the last in the centre, and the two former in the southern parts. Through the middle of the lower part of the county, the chalky hills extend: the substratum of the whole of Berkshire is calcareous. Wiltshire, in respect to soil, as well as in respect to the face of the country, is naturally divided into two districts; the south and east parts are composed of chalk hills, which enter the county from Berkshire, Hampshire, and Dorsetshire; among these hills, however, there are valleys of loamy soil. The west and north parts of the county consist, for the most part, of very fertile loam, which stretches south-east and south-west, under the foot of the hills: this tract varies a little in its soil, as the ground rises in the north-west corner, where it joins the high land of Gloucestershire. Below the middle of the county, Salisbury Plain, which has been already noticed, begins: the soil is a light loam, naturally fertile. In Hampshire, the woodlands and wastes of Bagshot consist of clay, sand, gravel, and peat. The second division of soil stretches from Basingstoke to Winchester, and in breadth extends entirely across the county: in this tract, strong flinty loams and hazel-coloured mould or chalk, occasionally mixed with gravel, prevail: in most of the valleys, peat is found. From Bishops Waltham to Christchurch, light sand and gravelly loams generally compose the soil; clay and strong loams, or brick earth, are however occasionally met with: the substratum is argillaceous and calcareous marl: on the heath and low grounds, peat and turf prevail. For some miles round Portsmouth, the soil is a strong flinty loam, lying very near the chalk. The Isle of Wight contains principally three kinds of soil: on the north side it consists of rough strong clay, lying on chalk; in the middle downs, and on the south side, soils of different qualities and degrees of strength, but almost universally very fertile: some of these loams approach to the lightness of sand, but still retaining their fertility.

The south-western district of England comprises the counties of Somersetshire, Devonshire, and Cornwall. In Somersetshire, there is great variety of soils, as well as very different degrees of fertility: the north-east quarter is in general stony: towards the centre, there are fens and marshy moors of great extent: on the west are downs and open heaths. The low grounds of Somersetshire in general consist of loam; on the borders of Dorsetshire, a stone brash soil, of considerable fertility, prevails: perhaps the most fertile parts of this county, are the vale of Taunton, and the district round Bridgwater. The district of Dartmoor, in Devonshire, consists principally of peat; where it is not found, the soil is a thin black mould, lying on pale clay, intermixed with gravel: the vale of Exeter consists principally of red land, of great fertility: the same kind of soil, of an equal if not superior degree of fertility, is found in the district of South Hams: the subsoil here is a strong clay. In West Devonshire, the prevailing soil is cold clay, on a substratum of rubble. North Devon, in general, is not more distinguished for the romantic character of the prospects it affords, than for the goodness of its soil, except on the summit of the hills, where it is thin. In Cornwall three descriptions of soil predominate: the black granite or gravelly; the shelly or slaty; and the loams. The first, which prevails in the western parts of the county, consists of a light black earth, resembling moss in its appearance and qualities, intermixed with small particles of granite. The slaty soil, which is the most extensive, is formed of schistose matter, mixed with loam: and, when properly managed, is by no means unfertile: but of loams, strictly so called, there is but a very inconsiderable quantity in this county: these lie, for the most part, on the low grounds, declivities, and banks of the rivers. The hills, which run through the middle of Cornwall its whole length, consist of very poor soil in general.

With respect to Wales, both North and South, the soils in general afford so little variety, that it will not be necessary to describe them minutely and particularly. In the vales and low grounds, they consist, for the most part, of loams of different degrees of fertility and strength. Some of the vales, especially in North Wales, may vie, in natural richness, with the most favoured districts of England. The sea-coast of some parts of South Wales consists of a sandy loam, which, from the moistness of the climate, is often very productive: the soil of the mountains is frequently thin and cold; but in some places dry and sound.
From this description of the soil of England, though necessarily brief and general, it will be sufficiently apparent that it is suited to almost every variety of produce; though, at the same time, much of it is naturally of such a quality and description, that without skill, labour, and capital, it would but ill repay the agriculturist, and but scantily supply the wants of the inhabitants. The soil of a country, however, ought always to be considered in reference to its climate: we have seen that the climate of England differs very considerably in different parts of the country; in some parts, it is so moist, as to point out the advantage, or the necessity, if the soil were of a proper description, of pasture; in other parts, it is comparatively so dry, as to be well suited to arable husbandry. The soil, also, varies in the same manner; in some districts, though midsted with soils of a different quality, it is evidently better fitted for grass than for the plough; while, in other parts of England, both the soil and the climate point out the advantage of arable husbandry. When we come to treat of the agriculture of this kingdom, we shall observe in what manner, and to what extent, these circumstances have been attended to and improved.

CHAP. V.

Natural History.

Our account of England would be imperfect, if it passed over its natural history; and yet our limits will not admit of a regular and complete treatise on that subject; we must therefore adopt a middle course, so as to give a clear idea of the natural history of this country, without pretending or endeavouring to give a full and regular account of it. The natural history of a country comprehends its Zoology, Ornithology, Amphibiology, Ichthyology, Entomology, and Helminthology, or what, in the more strict and limited sense of the term, is called Natural History. The species in the two last of these divisions are so numerous, that we shall content ourselves with noting the number contained under each genus that are found in England, and with particularizing only the most remarkable: For the CONCHOLOGY of England, we may refer to that article. In Botany, also, which forms the next division of Natural History, taken in its most comprehensive sense, we shall confine ourselves to a general description of the most remarkable vegetables found in England; referring such of our readers as wish to learn particularly what plants under each genus flourish here, to the article BOTANY.

The last division of our account of the Natural History of England, will embrace its Mineralogy, which will naturally lead to the consideration of its Geology.

Sect. I. Zoology.

Primates.

In the class Mammalia, and order Primates, the only genus that is found in England is Vespretilia, the bat. Of this we have four species: V. auritus, eared bat. V. murinus, common bat. V. noctula, great bat; and V. ferrum equinum, the tailed bat. The first is the most common of the English species; the third is the largest; the fourth is very rarely found here. Of the genus Phoca, belonging to the next order Ferae, we have two species: P. vitulina, sea-calf, or common seal; and P. barbata, great seal. The last, however, is very seldom seen on the English coasts, confining itself generally to the northern coasts of Scotland. Of the genus Canis, and species C. familiaris, there are several varieties in England; the most noted are the mastiff, bull-dog, and the different breeds adapted to the chase. C. vulpus; there are three varieties of the fox in England: the greyhound fox is the largest, tallest, and boldest; he will sometimes attack a fully grown sheep: the mastiff fox is not quite so high, but he is stronger built, and more heavy in his appearance: the least and most common of our species is the cur fox. Of the genus Felis, we have F. catus; the variety of this, which is wild, is still found in some of our woods, particularly in the county of Northampton, and is one of our most destructive beasts of prey. Of the genus Mustela, the M. lutra, or common otter, is very frequently met with in all parts of England: of the martin, we have two species, or perhaps only varieties, Mustela foenis, and Mustela martes, the common, and the pine martin; the former is more frequent found in this island, and is, of all the English beasts of prey, the most beautiful and courageous. Of this genus there are also found here M. putorius, the foumart; and M. vulgaris, the common weasel. Of the genus Ursus, the U. arctos, or common bear, is supposed to have been formerly native here: but if this opinion is correct, it must have been at a very remote period. U. meles, the badger, is too often the sport of the thoughtless or the savage part of the community. Genus Talpa, T. europea, common mole. Genus Sorex, S. fodien, the water shrew: this species is by no means common with us. S. araneus, common shrew. Genus Erinaceus, E. europaeus, hedgehog.

Of the order Glires, the first genus that is found in England is My<sub>r</sub>us: of this we have M. rattus, black rat; M. decumanus, brown rat; M. musculus, common mouse; M. sylvaticus, field mouse; M. amphibius, water rat. Of the genus <em>Sciurus</em>, S. vulgaris, common squirrel. Of the genus <em>Myapus</em>, M. muscardinus, common dormouse; in many parts of England, this little animal is called the sleeper. Of the genus <em>Lepus</em>, L. timidus, common hare; L. cuniculus, rabbit; this last will be noticed under the head Agriculture of England.

Of the order Pecora, the first genus we possess is <em>Pecora</em>. Cervus: C. elaphus, the stag, in its natural state, is very rare in England, but there are still a few remaining on the borders of the county of Cornwall. The usual colour of the English stag is a dusky red; but Buffon says the most common colour of the stag is yellow. C. dama, the fallow deer. There are two kinds of fallow deer in this country, said to be of foreign original; the beautiful dappled, originally imported from India; and the fine dark brown, introduced by James I. from Norway. Of the genus <em>Capa</em>, C. agrarius, the common goat. Mr Pennant remarks that the goats of Wales are commonly white, and far superior in strength, size, and fineness of hair, to those of other mountainous regions; their horns are likewise much longer and thicker at the base. The haunches of these animals are frequently salted and dried, and used as a substitute for bacon. The genera <em>Ovis</em> and <em>Bos</em> will be treated of under the division Agriculture in this article. With respect to the latter, we shall merely remark in this place, that the indigenous horned cattle of this island are now only known to exist in Needwood Forest in Staffordshire, and at Chillingham Castle in Northumberland. They are long-legged,
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**Ornithology.**

Order Cetæ. Genus Balana: B. mysticetus, the common whale, is sometimes found as far south as the coasts of England. Genus Delphinus: D. phocaena, the porpus; and D. orca, the grampus.

C. coroni, the carrion crow. C. frugilegus, the rook: this bird remains in England during the whole year, whereas in France they migrate. C. monedula, the jack daw: in Hampshire, where there are few towers or steeple, (in which these birds delight to build), they have been known to occupy rabbit-holes. C. glandarius, the jay: this is one of the most beautiful of the English birds. C. pica, the magpie. C. craculus, the Cornish chough: besides Cornwall, in which it is very common, and from which it takes its name, this bird is found in North Wales, inhabiting the cliffs and ruinous castles: a few are found on Dover Cliff, where a pair, sent from Cornwall, escaped, and have since stocked the spot, but do not appear much attached to it. The Corvus corax occasionally visits England. Genus Corvus: C. carrulus, the rook: this bird has been shot in England, but is only an occasional visitor. Genus Oriola: O. galbula, golden oriole, sometimes accidentally appears in this country. Genus Cuculus: C. canorus, the cuckoo: it is not ascertained whether this bird migrates from England or not. Genus Vulpes: Y. torquilla, the wryneck: it derives its English name from its often turning about its head. Genus Picus: P. viridis, green woodpecker. P. medius, middle spotted woodpecker. P. minvors, lesser spotted woodpecker: this species is not nearly so frequently met with in England as the others. Genus Sitta: S. europaea, European nuthatch. Genus Alcedo: A. isipida, the common kingfisher: this bird migrates from England. Genus Uropygs: U. epops, hoopoe: this species does not breed here, nor does it visit us at stated times. Genus Certhia: C. familiaris, the creeper: this is the least of our birds, except the crested wren.

Order Anseres. Genus Anas. A. cygnus, the wild swan. A. olor, the tame swan: this bird is the principal ornament of the artificial waters: it is of the nobility and gentry; and they are seen in great plenty on the Thames, where they are royal property: it is felony to steal their eggs. In the reign of Edward IV, whoever did not possess a freehold of the clear annual value of five marks, was prohibited from keeping a swan. Formerly, there was a noble swannery at Abbotbury in Dorsetshire, but the collection is now much diminished. A. tadorna, the sheldrake. A. nigra, the scoter: in very severe weather; during winter, this bird is sometimes seen on the English coast. A. albinon, white-fronted goose: this species visits the fens and other parts of England, during winter, in small flocks: none are seen after the middle of March. A. anser, the wild goose. The domestic goose will be considered when we come to treat of the agriculture of England. A. segetum, the bean goose: this bird migrates to England in autumn, from the Hebrides, where it breeds. A. moschata, Muscovy duck: this bird, a native of the Brazils, (and not of Muscovy, as has been supposed), would seem to indicate, if domesticated in this country. A. clypeata, the shoveller, remains with us all the year. A. rubens, the red-breast shoveller, is an uncommon bird even in Lincolnshire, where all the species of this genus abound. A. strepera, the gadwall, or gray. A. clangula, the golden eye. A. glandarius, the morillon. This species is seldom seen except on the sea coast. A. glacianus, bimaculated duck. This bird is not common

and wild, like deer; of a pure white colour, with black muzzles, ears, and tails, and a stripe of the same hue along the back.

Of the order Bellæae, the genus Egnus will be afterwards treated of; and also the genus Sus. The wild boar was formerly a native of our country, as appears from the laws of Hoel Dha, the Welsh legislator, who permitted his grand huntsman to chase that animal from the middle of November to the beginning of December. William the Conqueror subjected to the loss of their eyes those who were convicted of killing a wild boar in his forests. It is not exactly known at what period this animal became extinct in England.

Order Cetæ. Genus Balana: B. mysticetus, the common whale, is sometimes found as far south as the coasts of England. Genus Delphinus: D. phocaena, the porpus; and D. orca, the grampus.
in England. A. penelope, the pigeon, migrates from England to the north for the purpose of breeding, and returns in November; it is sometimes domesticated. A. acuta, the pin-tailed. A. ferroginea, ferrugineous duck; this is a rare bird in England. A. glacialis, the long-tailed duck, is only a transient visitor here. A. ferina, the pochard; this bird is very common in the poultry shops in London, where they are called dun-birds. A. querquedula: The garrancy continues in England only during the summer months, after which it migrates southward. A. crecca, the teal; birds of this species are common in the London markets. A. domesticus, the same duck, will be properly considered under the agriculture of England. A. boschas, wild duck, is taken in great numbers in the fens of Lincolnshire. A. fuligula, tufted duck.

Genus Mergus. M. merganser, the goosander. M. minutus, the rough diver; this bird is seen only in the north of England, and there only during the winter.

Genus Alya. A. arctica, the puffin; this bird is seen on the shores of the north of England, about the middle of April, for the purpose of breeding. A. torda, the razorbill, breeds in some parts of this country, but more commonly prefers the western isles of Scotland.

Genus Procelaria. P. pelagica, the stormy petrel; and P. puffinus, the shearwater, are occasionally seen off the coasts of England.

Genus Pelicanus. P. carbo, the cormorant; this bird is not uncommon round the high rocks of the Isle of Wight, where the sailors give the name of the Isle of Wight Parsons; it was formerly domesticated in this country, and trained to fish for the service of its master. Even so late as the reign of Charles I. it appears that there was an officer of the royal household, entitled master of the cormorants. P. bassanus, the gannett, or solan goose; this bird, in following its prey, is sometimes seen as far south on our coasts as Cornwall.

Genus Colymba. C. grylle; the spotted guillemot; this bird, common off the coast of Scotland, is sometimes seen off the shores of England. C. septentrionalis, the red-throated diver, is never seen, except in the hardest winters. C. stellatus, speckled diver; while the stints are in the Thames, this bird accompanies them, from which circumstance they are called spat-loons. C. cristatus, the crested grebe, breeds in the fenny districts of Lincolnshire, &c. C. auritus, the curred grebe, or dochick, also breeds in this country, though its regular abode is in the lakes of the north of Europe. C. obscurus: dusky grebe, like most others of this genus, is met with in great numbers in the fens, where it breeds. C. urinatix, greater dochick, or loon, is not a common bird in England.

Genus Larus. L. tridactylus, the tarrock; L. hybrimus, the winter gull; L. canus, the common gull; L. cinerarius, the legged gull; L. erythropus, the brown-headed gull, breeds not only in the fens of Lincolnshire, but also near the mouths of rivers, in other parts of England. L. fuscus, the herring gull; L. ridibundus, the black-headed gull; this species breeds in great numbers in the pools and fens of this country.

Genus Sterna. S. hirundo, the sea-swallow; S. minuta, the lesser sea-swallow; S. stellata, the black tern, abounds in the fens and in fresh water lakes.

Order GALE. Genus Ardea. A. grus, the common heron; the black crane, often visits England, and is sometimes seen in vast flocks in the fens of Lincolnshire and Cambridgeshire. A. cicinina, the common stork; A. major, the common heron. Heronries are yet met with in some parts of this country, though they are not nearly so numerous, or so carefully attended to, as they formerly were. A. stellarius, the bittern, about the time of Henry VIII. this bird was esteemed a delicious dish at the tables of the great. A. alba, the white heron, is not common in this country. A. minutus, the little bittern; this also is a rare bird.

Genus Scolopax. S. arctica, the common curlew, is very frequent on our sea coasts, and on the fens during the winter season. S. phaeopus, the whimbrel, is not nearly so common here as the former species. S. rusticola, the woodcock; these birds begin to appear in England early in October, but the great body do not arrive till November or December, when they disperse themselves over the country; towards the middle of March, they may be observed to be preparing themselves for their departure to their breeding places, coming down to the sea coasts; as soon as the wind is favourable, they leave this country, but a few sometimes remain behind and breed here; from the progress of cultivation, they are observed to be becoming gradually more scarce in England. S. major, the great snipe, is a rare bird in England. S. gallinago, the snipe; S. galinula, the jack-snipe, is much less frequent here than the former. S. pusilla, the dunlin, is common on the coasts of Yorkshire, but seldom met with elsewhere. S. glottis, the greenshank, appears in the winter time, in small flocks. S. calidris, the red-shank, is common in the fens of Lincolnshire. S. totanus, the spotted snipe, is a rare bird; as are also S. limosus, the stoneplover; and S. lapponica, the red godwit. S. neogoepepha, the common godwit, appears in the month of September on the coasts of Lincolnshire, in small flocks; they are taken in the fens and fattened, when they sell for five shillings a piece. S. canescens, the cinerous godwit, is also common in Lincolnshire. S. cantabricensis, the Cambridgeshire godwit, is generally met with in the vicinity of the town from which it takes its name.

Genus Tringa. T. pugnax, the ruff; these birds appear every spring in the fens of Lincolnshire, and other places of the north of England, where they make a considerable article of commerce. Above six dozen have been caught in a morning in one net; and a fowler has been known to obtain, for his own share, 40 or 50 dozen in a season. They leave this country about Michaelmas. T. vanellus, the lapwing; T. gambetta, the gambit, is a very rare bird, but it has been occasionally shot on the coast of Lincolnshire. T. maculata, the spotted sand-piper, is a bird of passage, and very seldom seen here. T. cinerea, the ash-coloured sand-piper: these birds appear on the coasts of this kingdom, in winter, in large flocks. T. lobata, the grey phalarope, and T. hyperborea, the red phalarope, are seldom seen on the coasts; the same is the case with respect to T. ochropus, the green sand-piper. T. hypoleucus, the common sand-piper. T. canutus, the knot; these birds are said to derive their name from King Canute, who was fond of them at table; they are taken in great numbers on the coast, and fattened in the same manner as the ruffs, to which they are preferred by many people. T. cinclus, the purtie; this species comes in very large flocks on the sea coasts during winter, and leaves this country in spring. T. pusilla, the little sand-piper. T. squatarola, the grey sand-piper, is not very common. T. islandica,
the red sand-piper; these birds sometimes appear in vast numbers off the coast of Essex.

Genus Charadrius. C. hiaticula, the ringed plover, frequents our shores in the summer. C. morinellus, the dotterel. C. pluvialis, the golden plover, is met with but in small flocks, on our moors and heaths, in the winter. C. calidris, the sanderling, is most common on the coast of Cornwall. C. oedicnemus, the stone curlew. C. himantopus, the long-legged plover, is a very rare bird in England.

Genus Recurvirostra. R. avocetta, the avocet, breeds on the shores of France, and during winter make their appearance in this county.

Genus Hematopus. The only species of this genus, H. ostralegus, is frequent on most of the shores of England.

Genus Pudica. F. chloropus, common water hen. F. atra, common coot. F. aterrima, greater coot.

Genus Rallus. R. crex, the rail, is a migratory bird; it begins to be heard about the middle of March, and continues its cry during the breeding season. R. aquaticus, the water rail. R. porzana, the spotted rail.

Order Gallinae. Genus Otis. O. tarda, the bustard, is not nearly so common in England as it was formerly; it is sometimes seen in the open country, near Dorchester; on Salisbury plain; near Newmarket; and on the wolds of Yorkshire. O. tetras, the little bustard.

Genus Pavo. P. cristatus, the peacock; and Genus Melanopsis: M. galloppavo, the turkey, are domesticated in England.

Genus Phasianus. P. Gallus, the cock, will be noticed, when we treat of the agriculture of this country. P. colchicus, the pheasant. F. pictus, the golden pheasant; birds of this species are common in most parts of England, particularly in the county of Norfolk; the female will sometimes hatch her eggs in the woods of this county, if undisturbed by the male; but the pheasant can scarcely be said to have been found in a state of nature in England, most of the birds being brought up in confinement, the eggs hatched under domestic fowls, and the young at a proper age set at liberty. If it were not for this method of rearing and preserving them, it is probable the breed would soon become extinct.

Genus Tetrao. T. tetrix, the black cock, is found in particular parts of the New Forest, in Hampshire, where it is preserved as royal game, and in Wales. T. lagopus, the ptarmigan, is sometimes, but very rarely met with, on the lofty hills of Wales and Cumberland. T. attaggen, the red grouse, is not uncommon in the heathy and mountainous parts of England; in Wales it is more plentiful. T. perdix, the partridge: it is observed that this bird follows cultivation, so that it is found on the inclosed common lands, where it was not wont to make its appearance. T. coturnix, the quail, though this bird is more extensively diffused than the partridge, it is not nearly so common in this country: it is a bird of passage, making its appearance here early in spring.

Order Passerinae. Genus Columba. C. oenas, the common pigeon: this is the parent stock from which C. domestica, the domestic pigeon, is derived; C. palumbus, the ringdove, this is the largest of the species in this country. C. turtur, the turtle dove, this is a bird of passage, arriving in England late in the spring, and departing about the latter end of August; in no county are they so common and numerous as in Kent, where they are sometimes seen in flocks of 20 or more; they frequent the pea fields, in which they commit great depredations.

Genus Alauda. A. arvensis, the sky-lark: about Christmas, immense numbers of this bird are taken and brought to the London markets; as many as 4000 dozen have been caught in the vicinity of Dunstable alone, between September and February. A. pratensis, the tit-lark. A. minor, the lesser field lark. A. arbores, the woodlark, is not common here. A. rubra, the red lark, is common in the neighbourhood of London, but seems to be rare in other places. A. trivialis, the grasshopper lark. A. nemorosa, the lesser-crested lark, is common in Yorkshire.

Genus Sturnus. S. vulgaris, the starling: in the fens of Lincolnshire, myriads of these birds collect, and break down the reeds with their weight. S. cinclus, the water ouzel.

Genus Turdus. T. viscivorus, the missel thrush: this bird, which in Hampshire has received the appellation of the storm cock, from its perching on lofty trees, and beginning its note a little before the new year, is the largest of our songsters. T. pilaris, the fieldfare, does not breed in England: it comes about the end of September, and leaves us about the middle of March. In Hampshire, a singular habit of this bird has been observed; it appears there generally about the 30th of September, and departs after a fortnight's stay. On its return it comes to the same place about the middle of April, and stays a week. T. ilinus, the red-wing, appears in this country a few days before the fieldfare. T. muscius, the thrush, is one of the finest of our song birds, and continues longest in song. T. rosnes, the rose ouzel; this bird is rarely met with in England; there are, however, a few instances of its being found. T. merula, the blackbird. T. torquatus, the ring ouzel, migrates in England, but in Wales continues the whole year.

Genus Ampelis. A. Garrulus, the Bohemian chaffinch, is seldom seen farther to the south in this country, than Northumberland and Durham: in the year 1791, several were taken in these counties, as early as the month of November.

Genus Loxia. L. curvirostris, the cross-bill. L. cothraustus, the cross-beak. L. enucleator, the pine cross-beak. L. pyrrhula, the bullfinch. L. chloris, the greenfinch: the two last species are tamed and domesticated.

Genus Emberiza. E. nivalis, the snow-bunting. E. montana, the mountain bunting, is found in Yorkshire and Northamptonshire, but is not common. E. citrinella, the yellow hammer. E. schenicius, the red sparrow. E. chloroccephala, the green-headed bunting, is a very uncommon bird, having been only once or twice taken in the vicinity of the metropolis.

Genus Fringilla. F. celebene, the chiffinch. F. carduelis, the goldfinch. F. canaria, the canary bird, was brought to England from the Canary Islands, about the beginning of the 16th century. F. spinus, the siskin. F. cannabina, the greater red pole. F. linota, the linnet. F. linaria, the lesser red pole. F. domestica, the sparrow. F. montana, the mountain sparrow.

Genus Muscicapa. M. tristripilla, the pied fly-catcher, is sometimes, but very rarely seen here. M. grisa, the spotted fly-catcher, breeds in England, but migrates in August.

Genus Motacilla. M. lucina, the nightingale, visits England in the beginning of April, and leaves it in August. It is not found to the north of the middle of
Yorkshire, nor in the south-western counties. M. modularis, the hedge sparrow; M. hippoclae, the petty-chap; M. salicaria, the red sparrow; M. sylvia, the white-throat; M. provincialis, the Dartford warbler, as its name imports, is almost confined to the neighbourhood of Dartford in Kent. M. alba, the white wagtail; M. flavus, the yellow wagtail. In the north of England it migrates, but remains in Hampshire during the whole year. M. oenanthe, the wheat ear, is taken in great numbers, in July and August, on the South Downs, the isle of Portland, and on the hills of Surry and Hampshire. M. rubetra, the wheatear, remains the whole year in the southern counties of England. M. ruricola, the stonechat; M. atracapaillla, the black cap; M. phanerius, the red start; M. arundinacae, the red wren, has been seen in few places except the vicinity of Uxbridge. M. rubecula, the redbreast; M. troglodytes, the wren; M. regulus, the golden crested wren, is the least of our birds. M. trochilus, the yellow wren; M. barula, the grey wagtail.

Genus Parus. P. major, the great titmouse, or oxeeye; P. ceruleus, the blue titmouse; P. ater, the cole mouse; P. palustris, the marsh titmouse; P. caudatus, the long-tailed titmouse; P. biarmicus, the beard-titmouse.

Genus Hirundo. H. rustica, the chimney swallow, appears in March or April, and retires in September or the beginning of October. H. urbica, the martin, the "temple haunting martlet" of Shakespeare, comes and stays later than the preceding species. H. riparia, the sand martin; H. apus, the swift, is the largest of our swallows; it comes in May and departs before the middle of August.

Genus Caprimulgus. C. europaeus, the goat-sucker; this is the only bird of this genus that inhabits England.

Amphibiology.

Order REPTILIA. Genus Rana. R. bufo, the common toad; R. rubeta, the natter jack; R. temporaria, the common frog.

Genus Lacerta. L. palustris, the warty lizard; L. aquatica, the water lizard; L. agilis, the nimble lizard; L. vulgaris, the common lizard; L. aurata, the gilded lizard, is found only in Jersey.

Order SERPENTES. Genus Coluber. C. borus, the viper, is the only poisonous animal in this country; C. prester, the black viper; C. natrix, the ringed snake, is the largest of the species found here.

Genus Anguis. A. cryx, the blue-bellied snake; A. fragilis, the blind worm.

Order NAYNTS. Genus Tetrodon. T. mola, the short sunfish, is taken on the western coasts of England; Borlase speaks of one caught near Plymouth, that weighed nearly 500 pounds.

Genus Synagathus. S. typhle, the shorter pipe-fish; S. acus, the longer pipe-fish; S. opilio, the little pipe-fish.

Genus Cyclopterus. C. cornuicenisi, the Jura sucker, inhabits the seas off Cornwall; C. bimaculatus, bimaculated sucker, is found off Weymouth.

Genus Lophius. L. piscatorius, the toad-fish.

Genus Aeppenaeus. A. sturio, the sturgeon, is sometimes found in our larger rivers. It is accounted a royal fish.

Genus Squatius. S. anguila, the greater dog-fish; S. catulus, the lesser dog-fish; S. galeus, the tope; S. mustelus, the smooth hound; S. vulpes, the sea fox, is found on the coast of Cornwall. S. galeus, the blue shark; S. cornutus, the Porbeagle shark; S. maximus, the basking shark; S. carcharias, the white shark. These sharks, especially the last species, are not often seen in our seas. S. acanthias, the piked dog fish; S. spinax, the lesser piked dog fish; S. aequana, the angel fish, on our coast, is frequently caught of the weight of 100 pounds.

Genus Raia. R. torpedo; the torpedo has been occasionally taken in Torbay. R. batis, the skate; R. oxyrinchus, the sharp-nosed ray; R. fullonica, the white horse; R. pastinaca, the sting ray; R. clavata, the thornback.

Genus Petromyzon. P. marinus, the lamprey; P. fluviatilis, the lesser lamprey; P. branchialis, the pride.

Ichthyoology.

Order APODES. Genus Murana. M. ophius, the sea serpent; M. anguilla, the eel; M. conger, the conger eel.

Genus Anarchichas. A. lupus, the sea wolf, is eaten sometimes by the English fishermen.

Genus Ammodites. A. tobias, the sand eel.

Genus Ophidium. O. imberbe, the beardless opilio, is taken near Weymouth.

Genus Xiphius. X. gladius, the sword fish, sometimes appears on our coasts.

Genus Leptocephalus. L. mori, the morris launce, has seldom been seen, except in the sea near Holyhead.

Order JUGULARES. Genus Callionymus. C. lyra, the Jegulares; gommmeous dragonet; C. dranumus, the sordid dragonet.

Genus Gadus. G. anguiss, the haddock; G. morius, the cod; G. luscus, the bib; G. barbatu, the whiting-pout; G. minutus, the poor; G. merlangus, the whiting; G. carbonarius, the coal-fish. G. pollichius, the pollack; G. merluccius, the hake; G. molva, the ling; G. lota, the burbot; G. mustela, the five-bearded cod.

Genus Blemius. B. gallerita, the crested blenny; B. pholis, the hake, is found on the coast of Cornwall; B. pholis, the smooth blenny; B. gunellus, the spotted blenny; B. viviparous, viviparous blenny.

Order THORACICII. Genus Gobius. G. niger, the Thoracici; miller's thumb.

Genus Cotius. C. cataphractus, the pogge; C. scorpius, the father lasher; C. gobio, the bullhead.

Genus Zeus. Z. faber, the doree, is met with principally off the coasts of Devonshire and Cornwall. From its hideous appearance, it is said, that it was not introduced to English tables, till Quin, the epicure and coo-median, introduced it. Since his time, it has been esteemed one of the greatest delicacies. Z. luna, the ophid, has been sometimes thrown on the coast of England. One was taken near Newcastle in 1767; and another, weighing 140 lbs. was caught at Brexham, near Torbay.

Genus Pleuronectes: P. hippoglossus, the holibut; P. platessa, the plaice; P. flesus, the flounder; P. lindara, the dab; P. solea, the sole; P. rhomboides, the-kit, or smear dab, is found on the coast of Cornwall; P. rhombus, the pearl; P. maximus, the turbot.

Genus Sparus: S. auratus, the gilthead; S. pagrus, the red gilthead; S. dentatus, the toothed gilthead, is seldom met with; one was left by the tide, and taken in the mouth of the Terees.

Genus Labrus: L. tinca, the wrasse; L. bimaculatus, bimaculated wrasse: this species is found off the coast of Cornwall; L. trimaculate, the trimaculated wrasse, is found off Anglesey; as are also the next
species, L. variegatus, the stripped wrasse, and L. gibbus, the gibbus wrasse: the three next species are most commonly met with off the Cornish coast, L. cornubius, the goldfinny; L. comber, the comber; and L. coquus, the cook.

**Genus Percus**: P. fluviatilis, the perch; P. puncta, the basse; P. marina, the sea perch; P. cernua, the ruffe; P. nigra, the black fish, is found in the rivers in Cornwall.

**Genus Gasterosteus**: G. aculeatus, the bar stickle, is found in such abundance in the fens and rivers in Lincolnshire, that, according to Pennant, a man earned four shillings a day, by taking and selling them to the farmers for manure, at a halfpenny a bushel; they make their appearance off this coast only once in seven or eight years; G. doctor, the pilot fish, very rarely comes near our coasts, but is sometimes seen in our seas, at a considerable distance from land; G. pungitius, the lesser stickleback; G. spinicauda, the larger stickleback.

**Genus Scophus**: S. scomber, the mackerel. An economical account of this, and other fish caught in the rivers and off the coasts, will be given, when we come to treat of the English fisheries; at present, we shall merely mention a fact connected with its natural history: Pennant mentions an instance of one taken on the English coast, that weighed five pounds. S. thymus, the albicore; S. trachurus, the scad.

**Genus Mullus**: M. barbatulus, the red mullet; M. surmuletus, the striped mullet.

**Genus Triola**: T. lyra, the pipe; T. gurnardus, the grey gurnard. This fish seems to grow to a larger size in the English seas than elsewhere, as here it has been caught from two to three feet long, whereas in the Baltic it is seldom more than a foot and a half. T. cuculus, the red gurnard; T. hilarudo, the tub-fish; T. iliceta, the streaked gurnard, is met with off the coast of Cornwall.

**Order Abdominales**: Genus Cobitis: C. barbatula, the loche; C. taenia, the armed loche.

**Genus Salmo**: S. salax, the salmon, has been taken in England of the weight of 74 pounds; S. eriotha, the grey; S. trutta, the sea trout; S. Fario, the common trout; S. carpio, the gill char; S. alpinus, the char, is found in the lakes of Cumberland; S. eperlanus, the smolt, or spraling; S. lavaretus, the gudgin, is found in the lakes of Cumberland and Wales; S. albula, the juvansis, is said to have been carried from England into Scotland by Robert Bruce; S. thymus, the albicore, the scad.

**Genus Esox**: E. osseus, the great gar-fish, is taken off the coast of Sussex; E. lucius, the pike; E. belone, the sea pike; E. saurus, the saury. In Cornwall, where this fish abounds, it is called the skipper.

**Genus Argentina**: A. sphyraena, the argentine, has been found in our seas, but is very rare.

**Genus Clupea**: C. harengus, the herring. According to Pennant, there is sometimes taken near Yarmouth, a herring, distinguished by a black spot above the nose, which has been seen of the great length of 214 inches. C. sprattus, the sprat; C. alosa, the shad.

**Genus Cyprinus**: C. barbus, the barbel; C. carpio, the carp. According to Fuller, this fish was introduced into England, in 1514, by Leonard Mascali. C. gobio, the gudgeon; C. tinca, the tench; C. auratus, the gold fish; this fish was introduced into England about the year 1691, but was not generally known till 1728, when a great number were brought from China, and presented to Sir Matthew Decker, by whom they were distributed in the vicinity of the metropolis. C. poecilius, the minnow; C. leuciscus, the dace; C. rutilus, the roach; C. brama, the bream.

**Entomology**

**Order Coleoptera**: Genus Searabes: Of the 433 Coleoptera, species of which this genus consists, upwards of 30 are natives of England. The Searabes auratus, golden beetle, is considered one of our most beautiful insects. Searabes fasciatus is rare in England.

**Genus Lucanus**: L. cervus, the stag beetle, is the largest of the order Coleoptera found in this country. It is very common in Kent and Sussex.

**Genus Dermestes**: Of this we have six species.

**Genus Bostrichus**: B. piniperda often commits great devastation on the bark of elms in England. There are four species of this genus; and the same number of the genus *Pius*, and of the genus *Hister*. Genus *Cyrtinus*, G. Natator. Genus *Byrrhus*, B. pilula, and B. varius. Genus *Annulatus*, A. scrophulari, and Verbacis. Of the genus *Silpha* there are twelve species, of the *Nithidia* five, and the same number of the genus *Cassida*. Of the 150 known species of the *Coccinella*, 17 are very common. Of the genus *Chrysomela*, C. Banksii is a rare insect here, but is found in the month of May on a thistle: Besides this, we possess upwards of 30 other species. Nearly 20 species of the genus *Cryptoleon*, which was formerly arranged as Chrysomela, are met with. We have only one species of the *Bruchus*, B. sebroosus. Of the genus *Carcelia* there are upwards of 60 species, four of the *Atelabus*, two of the *Notocerus*. Of the *Cerambyx*, very few are natives; C. coriarius is the largest species. C. violaceus is very rare, and is supposed to have been introduced from Germany. Of the *Leptura* there are six species, of the *Neudalas* three. Of the *Lampyris*, only two species are caught here, and they are by no means common even in the south of England. We have one species of the *Horia*, 11 of the *Cantaria*, 13 of the *Elatia*, four of the *Cicindela*. The C. aquatica is the least of our species. Very few of the numerous genus *Buprestis* are natives of England, only eight having been found. There are four of the *Hydrophilus*, 12 of the *Dytiscus*. Amongst the species of the *Carabus*, or ground beetle, are found some of our largest insects: We possess 26 species of it; two of the *Tenebrio*, five of the *Pimela*; only one of the *Lyta*, L. nuditula; two of the *Meligus*; M. tecta is found in Epping Forest, in July; five of *Mordella*; 15 of *Staphylinus*; two of *Farctica*; F. minor, however, is not common.

**Order Hemiptera**: In this, and the remaining orders, we must content ourselves with specifying the genera found in England, with occasional notices of the more remarkable species: *Blatta*, *Gryllus*, *Fulgora*, *F. Europea*, very rare; *Cicada*, C. sanguinolenta, found on the chalky and sandy soils near Dartford, the most beautiful of our Cident; *Notoceles*, *Nepa*, *Cimex*, *C. rectangula*, the common bug, was not known before the beginning of the 17th century; *C. festivus* is not common; *Aphis*, *Chermes*, *Coccus*, *Thrips*.

**Order Lepidoptera**: Genus *Papilio*: Of the 877 Lepidoptera, species, we possess nearly 70. P. machon, the swallow tail, is found in great numbers in the meadows near Bristol. P. hero is very abundant in the marshy parts of Lancashire, near Manchester. P. populi and P. antiope are not common. The rarest of our species are P. si-billa and P. camilla; the largest, P. paphia. Genus
ENGLAND.

Species. Of this we have 20 species; S. aurota, the Jasmine hawk moth, is the largest; S. celerio, S. fueiformis, S. zonata, and S. chrysothoia are very rare,—the last is found in Kensington Gardens in June; S. apiformis is found in Sussex. Genus Phalaena, of the 13 species which this genus contains, upwards of 300 are natives of England.

Order Neoptera. Genus Libellula: Of this we have 12 species; L. grandis is the largest, and is inferior in bulk to no insect which this country produces. Genus Ephemerina, nine species; E. vulgata is the largest. Genus Phryganecia, 16 species; P. hirta is rare, but has been found at Oxford. Genus Hemerobius, 7 species. Genus Panorpa; of this only one species, P. communis is known here. Genus Raphidia, two species.

Order Hymenoptera. Genus Cynips, nine species. Genus Tenthredo, 19 species. Genus Syrphus, three species. Genus Ichneumon, 44 species. Genus Sphex, six species; S. spirifex has been found near Peterborough. Genus Tiphus, two species. Genus Chalcis, one species. Genus Chrysia, four species. Genus Vespa, 11 species. Genus Aphis; on the English species of this genus, Mr Kirby has written with minute, accurate, and extensive knowledge, and ascertained them to be even more numerous than they were previously supposed to be. Genus Formica, four species. Genus Mustula, one species.

Order Diptera. Genus Oestrus, five species. Genus Tipula, 52 species; T. Ponomae is very rare; T. zoanata has been found at Oxford. Genus Musca, 86 species; M. semi-argentata has been found in Epping Forest. Genus Tabanus, six species. Genus Culex, five species. Genus Empis, four species. Genus Stomoxys, three species. Genus Conope, four species. Genus Asilus, 11 species; A. Crabiformis is the largest, and A. forcipatus is the commonest species in England. Genus Bombylius, three species. Genus Hippobosca, four species.

Order Apidae. Genus Lepisara, two species; L. saccharinum has been brought hither from America. Genus Podura, eight species. Genus Nemes, two species. Genus Pediculus, 32 species. Genus Pulex, one species. Genus Acras, 24 species; A. autumnalis is not common, except in the chalky districts of Hampshire, Surrey, Kent, Sussex, &c. where it is called the harvest bug. Genus Hydracena, eight species. Genus Physaligum, seven species; P. grossipes and P. hisutum have been chiefly found at Milford haven. Genus Aranea, 18 species; A. aquatica is among the largest. Genus Cancer, 36 species; C. salinus is found in the salt pans at Lynmouth. Genus Monoculus, 10 species. Genus Oniscus, 10 species; O. bidentatus has been found near Milford haven. Genus Scolopendra, four species. Genus Julus, four species.


Order Mollusca. Genus Limax, six species; L. larnecolaris (if it may be considered as a Limax) is found in the sea, off the coast of Cornwall. Genus Aplysia; A. deplana is found in the sea about Anglesey. Genus Doris, four species. Genus Aphydritis, six species; A. plana has been taken off Brighton. Genus Amphitrite, one species. Genus Nereis, three species. Genus Neis, three species. Genus Acestus, four species; A. mammillaris is principally found off the coast of Cornwall. Genus Actinia, six species; A. carphophyllum is principally met with at Teignmouth; A. sulcata on the rocks off the Cornish and Welsh seas, and A. Dianthus on the rocks near Hastings. Genus Pediocellaria, one species. Genus Holothuria, one species. Genus Lernaea, four species. Genus Sepia, four species; S. sepia is taken off the coast of Flintshire. Genus Mollusca, five species; M. octopus and simplex are principally taken off the coast of Cornwall. Genus Asterias, eight species; A. membranacea is found at Weymouth.

Order Zoophyta. Genus Taphibora, one species. Genus Madrepora, one species. Genus Millepora, nine species; a variety of M. fassialis is found on the coast of Cornwall; M. alga is found on the same coast. Genus Celleporea, one species. Genus Gorgonia, three species; G. placoanus and G. verrucosa are found off the coast of Cornwall. Genus Aleyronium, six species; A. schlosseri is found on the coast of Cornwall and Wales, and A. ascidiodes off the former coast. Genus Spongia, nine species. Genus Pista, eight species. Genus Tubularia, seven species; T. indivisa is the largest; T. flabeliformis is found at Milford haven. Genus Corella, seven species; C. squamata, C. elongata, and C. corniculata are principally met with off the coast of Cornwall. Genus Scutaria, 48 species; S. pustulosa is found off the isle of Wight. Genus Pennatula, one species. Genus Hydra, eight species; H. Cereus, H. Bellis, and H. Gymnasea are found on the coast of Cornwall. It is unnecessary to specify the genera and species of the order Infusoria, as they are met with in water, or in infusions made with vegetable and animal matter, and consequently not properly natives of any country.

Sect. II. Botany.

It would far exceed our limits, as well as be going beyond the object and nature of this article, to particularize the plants which are natives of England: Referring our readers, therefore, to the article Botany, where the habitats of English plants are given, or at least such as are natives of England are specified, we shall content ourselves here with a general description of English botany, and on this description we shall borrow from Mr Aiken, as being at once concise, accurate, and elegantly written.

"Among the numerous species of vegetable which are natives of England, scarcely any are adequate to the sustenance and clothing of man. Our frequent rains, our blasting winds, and the scanty portion to which we are stinted of the light and heat of the sun, deprives us entirely of those vegetable treasures which, in the tropical climates, offer themselves, in overflowing exuberance, to satisfy the wants and luxurious desires of their human inhabitants. The never-failing verdure of our plains and hills, covered with a rich carpet of grasses and philanthaceous plants, shows how admirably our country is
qualified for the support of graminivorous quadrupeds; and we find, accordingly, that our ancient forests abounded in stags and roe-deer, as our cleared and cultivated lands do now with sheep and cattle.

The flora of England, though it cannot boast the most splendid and exquisite of vegetable productions, yet contains as great a variety of genera and species as any other country of equal extent. The investigation of indigenous plants is continually carrying on here with increasing ardour, and every year brings new accessions to our crowded ranks of native vegetables.

The first for importance and variety is the family of grasses. Almost every part of the country that is not under tillage, is principally covered with grass. Under almost all the differences of soil and situation, we find the chief covering of the richest, as well as of the most barren tracts, made up, for the most part, of these plants. To these we are indebted for the luxuriant verdure of our pastures—for the close velvet carpeting of our downs and sheep-walks—and the more scanty clothing of our mountainous districts. Twenty-seven genera, and 110 species of grass, are natives of our island, most of them of common occurrence in situations where they are found at all. None of them have been proved to be poisonous, either to man or beast; on the contrary, whether fresh or dried, they furnish a grateful food to all our domestic cattle. The most important grasses in meadows and pastures, are the meadow fowl grass; two or three species of hair-grass and meadow grass; the cocks-foot fescue, and oat grass. Other species are natives of marshes and wet places: These are generally the largest and most luxuriant; and if in quality they be somewhat inferior to the preceding, yet the defect is probably more than compensated by the quantity of herbage which they supply. Light sandy soils, especially the flat parts of the southern and eastern coasts, abound in grasses that are hardly to be met with in the interior of the island: the herbage of these affords a coarse and scanty pasture; and they are eminently distinguished from their kindred species by the length and strength of their creeping roots. Upon the sides and summits of our mountains are found a few grasses that do not appear elsewhere, mixed with some others of more general occurrence. As, however, in these bleak and elevated situations, covered with snow for some months in the year, and shrouded with clouds for the principal part of the remainder, it would be scarcely possible for these plants to bring their seeds to maturity, we observe in them a wise and striking deviation from the common course of nature: like the rest of their tribe, they throw up flowering stems, and bear blossoms; but these are succeeded, not by seeds, but by bulbs, which in a short time vegetate, and are already furnished with a leaf and roots before they fall to the ground. All the viviparous grasses, except one, (Festuca vivipara,) if transplanted to a lower and warmer situation, accommodate themselves to their new climate, and produce seeds. Besides these, there are others of a more hardy constitution, which appear to be the true natives of the mountains, and multiply their species by seed in the usual way. Nearly allied to the grasses; in general habit, are a number of species, natives of moors, bogs, and pools. These serve to give consistency to the deep mud, or peat, in which they are rooted, and, when young, afford a coarse pasture to sheep and cattle. Several of them are used for matting, thatching, and for chair-bottoms. The stately Typha (Bull-rush) is one of the principal ornaments of our fens and neglected pools; and the several species of cotton grass enliven many a dreary mile of bog, by their gracefully pendent tufts of snowy white.

The leguminous, or papilionaceous plants, so called from their winged blossoms, form a very important division in English botany. The herbage of all when fresh, and of many when dry, is a most grateful food to horses, cattle, and sheep; and several of them, as the clovers and vetches, are largely cultivated for this purpose. Many of this class are climbers, and adorn our thickets and hedges with elegant festoons of blossoms and foliage. Almost all the English papilionaceous plants flourish best in light calcareous soils, either rocky or sandy; and some of them, as the lady's finger and saffron, may be reckoned certain indications of chalk or limestone.

The umbelliferous plants form another large class in the natural arrangement of English vegetables, consisting of about 60 species. The roots and seeds of those kinds which grow on dry light soils, are frequently aromatic; those that are natives of marshes and moist meadows, are, for the most part, in a greater or less degree, poisonous. The whole class, indeed, is a suspicious one, and, excepting the fennel and celery, not a single native species is cultivated for the food of man or beast.

Perhaps the most splendid of all the herbaceous plants are the bulbous rooted, which, from their general resemblance to the lily, have obtained the name of lilaceous; most of these, however, are natives of warmer climates. The sandy deserts about the Cape of Good Hope, and the shores of the Indian Ocean, produce the most beautiful species. Of those which are found wild in England, there are only 28 species; and the greater number of these are of rare occurrence in a truly native state. The spring and autumnal crocus, the snow-drop, the snow-flake, the three kinds of narcissus, including the daffodil, the fritillary, tulip, and lily of the valley, are more familiar to us as garden plants, than as natives of our woods and pastures. The common ones of this class are ramos, a species of garlic, meadow saffron, and the beautiful and fragrant harebell, or wild hyacinth, one of the principal ornaments of our groves and thickets, even at such a time when they are profuse of beauties.

Our native fruits belong to the class of rosaceous plants; such as the wood strawberry, the bullace and black thorn, the hawthorn, crab and mountain ash, the common bramble or blackberry, the raspberry, stone-bramble and snowberry. The cherry, the medlar, the service, and pear tree, whose fruit, when wild, is of so little account, and of such value when improved by cultivation, belong also to this class.

One of the largest of the natural classes of English vegetables, is that of the radiated or compound flowering plants, (including about 120 species). It is rather remarkable, that out of so large a number of plants, many of which are very abundant, and of great size, only a single one, the Fragoponon porifolius, (Parsley,) should be applied to the sustenance of man, and not even a single one should be cultivated for the use of cattle; more especially as the Lactua virosa, (strong-scented lettuce,) is the only species possessed of deleterious properties. Most of this class have an ungrateful bitter taste, and the succulent ones contain a white milky juice, of an acrid flavour. Of all our native vegetables, they are the commonest, thriving by neglect, and multiplying by persecution. The farmer and gardener are unceasingly employed in their destruction, for they contribute...
little or nothing to the support of man and the larger
quadrupeds; nor is the beauty of their appearance such
as to obtain for them a place in the flower garden. The
annual kinds, however, producing vast multitudes of seeds,
and the perennial ones being furnished with long and
deeply striking roots, there is no fear of their expan-
sion. They occupy road sides, ditch banks, and all
waste places that are incapable of cultivation, and seem
peculiarly devoted to the sustenance of the granivorous
birds by their seeds, and of numerous tribes of insects by
their foliage. The sow thistle, hawk weed, burn-dock,
thistle, cud-reed, coltsfoot, groundsel, dandelion, daisy,
and yarrow, are the most commonly occurring genera.

Such of our trees and shrubs as have not been already
mentioned, may be considered as forming a peculiar class,
and one of great importance; it is naturally subdivided
into the evergreen and deciduous. The most valuable
of our native evergreens are, the box, the pine, the yew,
and the bolly. Those of secondary consequence are the
juniper and ivy. The spurge laurel, the cranberry, and
those extremely ornamental plants, the Vaccinium vitis-idaea
(red whortle berries), and Arbutus unc us u rs i, (bear
berry).

The deciduous timber trees, that are either aboriginal,
or at least have been long naturalized to our soil, are the
oak, the chestnut, and beech, all of which are moist bear-
ing trees, or produce farinaceous oil nuts, the favourite
food of hogs, and of many granivorous quadrupeds;
the birch, the alder, the horn-beam, the oaks, the pop-
ular, and the aspen, bearing catkins; the sycamore,
the maple, and the ash; the lime, the elm, and the wych-
hazel. A middle station between the timber trees and
shrubs, is occupied by the hazel and the numerous species
of willow. The pulpy fruit-bearing shrubs are, the
currant and gooseberry, the elder, the barberry, the bil-
berry, the cornel or dogwood, the buckthorn, the guelder-rose,
and the mazereon. The four first are wholesome, and
grateful to the palate; the rest are either insipid or noxi-
ous.

The ferns comprise a number of elegant plants, that
grow in moist, shady, and uncultivated places, the uses
of which have been but little inquired into. About 44
species are natives of this country. The roots of most
abound in a mild sweetish mucilage, which in times of
scarcity has been resorted to for nutriment. The larger
and commonest kinds, such as common ferns and brakes,
are collected and burnt for the potash, which is yielded
from their ashes. The Equisetum hyemale, (shave grass),
is much used by turners and cabinet-makers, as a fine
file to smooth their work with.

The last class of English vegetables that we shall men-
tion, is that of the marine algae, or sea weeds. Between
200 and 300 species are found upon our own shores.
The more tender and gelatinous kinds are eaten, either
raw or boiled; and the rest, on those rocky parts of the
coasts where they can be collected in great quantities,
are burnt into kelp for the use of the soap boilers and glass
makers.

SECTION III. Mineral Geography, and Geology.

The last branch of the natural history of England re-
lates to and comprises an account of its mineralogical
and geological. The minerals, in an economical point of view,
will be considered afterwards: At present we shall con-
fine our observations respecting them to those particular
which regard and illustrate their natural position and
history. For the geology of England, the materials are
yet very unsatisfactory and incomplete. In fact, it is a
science still in its infancy: but as geologists, at length,
seem to be convinced of the advantage and necessity of
accumulating and comparing facts, resting on minute
and accurate investigation, before they venture to pro-
cede to form theories, or even to lay down general prin-
ciples, we may hope that geology will soon be advanced
to the dignity and precision of a science. The Geologi-
cal Society has done much; and, from the nature and ob-
ject of its investigations and inquiries, as well as from
the character of its leading members for philosophical
views and general information, much more regarding the
geology of England may fairly and confidently be expected
from them. In what we are about to advance respecting
the mineralogy and geology of England, we shall be
much indebted to their labours; nor shall we pass over
the work of Mr. Bakewell, entitled, “An Introduction to
Geology, comprising an outline of the Geology and Min-
eral Geography of England;” for though in this work
there is a lamentable and discouraging want of arrange-
ment and method, and on many points erroneous or incomplete
information; yet on the whole it must be regarded as a
respectable and useful performance on this subject, at
least till a more scientific and complete one makes its
appearance.

If a line be drawn from the western side of the isle of
Portland, passing through Dorsetshire, about half way
between Dorchester and Bridport, and going a few miles
to the west of Oxford and Northampton; and a very
short distance to the east of Leicester and Nottingham;
and afterwards inclining rather to the west, so as to include
Doncaster and York between it and the German Ocean;
and at length sweeping round the last town in a direction
near to north-east, so as to reach the vicinity of Scar-
borough, it will include between it and the German Ocean
the whole of the low district of England, which is com-
posed of chalk, calcareous sandstone, and other secondary
strata or alluvial ground, and in which no beds of work-
able coal or metallic veins occur. To the west of this
imaginary line, the country is composed of secondary
strata, of a different description, in many parts of which
beds of ironstone and coal are found. This Mr. Bake-
well denominates the middle district. On the north,
this district is bounded by mountains of metaliferous
limestone, which entering England from Scotland, pro-
cede nearly through the centre of the former county,
and terminate in Derbyshire; the same species of coun-
try makes its appearance in the south-western counties
of England and in Wales. The primary and transition
mountains, in which metallic ores occur, are met with along
the western side of the island. These constitute the alpine
district of England, extending from Cornwall and Devon-
shire through Wales, into the north-west parts of York-
shire and Lancashire, and through Westmoreland and
Cumberland. It may be remarked, however, that the
calcareous strata of the low district appear on some parts
of the eastern side of Durham and Northumberland be-
yond Whithy. The principal coal-fields lie in that part
of the middle district, which stretches from Derbyshire
to Northumberland, and in that part of Wales which
borders on the Bristol Channel. On the western side
of Cumberland, the coal strata border on a small part of
the alpine district, and dip under the sea. In the centre
and east of England, the strata generally decline to the
south east; on the western side they are more broken
and irregular. In a direction south-east from Nantwich
in Cheshire to Worcester, all the rock salts, and most of the brine springs, are situated.

- Having given this general description of the geology of England, we shall now proceed to a more particular account of it, as well as of its mineral geography.

What has been denominated the low district of England is distinguished, as has been already remarked, by the absence of any regular beds of coal or metallic veins. Chalk, oolite, calcareaeous sandstone, and earthy limestone, principally compose it. Earthy limestone and calcareaeous sandstone, extend from Dorchester to Northamptonshire, and on the eastern side of Leicestershire, Nottinghamshire, and Yorkshire, into part of Durham and Northumberland. The earthy limestone in this district is far from being pure: it is generally of a yellow colour, and some of it contains 20 per cent. of magnesia.

In the magnesian limestone, there are few organic remains. The strata lie very nearly horizontal, and are, in almost every situation, very distinctly seen. Magnesian lime, however, occurs in this district, composed of beds that are singularly contorted and much elevated. Between the chalk and the limestone, different kinds of calcareaeous sandstone occur; the most singular and important, is the oolite or roe-stone, of which the Portland stone, and the Ketton stone of Northamptonshire are varieties. The roe-stone is separated from the chalk by beds of sand and sandstone mixed with clay: these extend with a considerable degree of regularity over the whole of the south-east of England, but vary much in their thickness. It has, however, been remarked, that in the midland and northern counties, less regularity can be distinguished, and that many of the strata, which are distinctly seen in the south, are there entirely missing. Above the chalk, in the low district, lie, in general, thick beds of clay and gravel. In the upper part of this clay, the bones of the elk, the hippopotamus, and the elephant, have been found. In the southern counties, from Dorsetshire to Kent, and in the midland and eastern counties of Wiltshire, Berkshire, Hertfordshire, Buckinghamshire, Essex, Cambridge, Norfolk, Lincoln, and the east riding of Yorkshire, chalk makes its appearance, in different situations, from under the clay. As the general rise of the strata is to the north, as we approach the coal districts, the strata, which lie under the chalk, rise to the surface. The depth and succession of the strata between the chalk and the coal, have not been ascertained with any degree of minuteness and accuracy, except in one or two places. Mr. Townshend, in a work, entitled, "The character of Moses vindicated as an Historian," has given the following as the thickness and succession of the strata from the chalk on the south coast to the coal districts of Somersetshire.

- Soil and alluvial ground, various thickness; chalk more than 400 feet; three beds of green, grey, and red sand, with sandstone, 300 feet; clay 200 feet; superior oolite, or roe-stone, 40 feet; calcareaeous grit, 30 feet; coral rag, 30 feet; forest marble, 40 feet; great oolite, or Bathstone, 140 feet; clay, 140 feet; inferior oolite and sand, 80 feet; blue clay, 70 feet; lyes, 60 feet; and red marl, 180 feet. Hence it is probable, that, allowing for the depth of the stratum of clay over chalk, the depth of the strata in that part of the low district of England, which comprehends the vale of the Thames, to the strata containing coals, will amount to about 700 yards; but if we estimate the depth of the argaliceous strata, containing coal, where the chalk terminates, and the subjacent sand rises from under it, as at Woburn in Bedfordshire, it probably will not amount to more than 350 yards.

It has been already remarked, that the mineral products of this district are few and trifling: iron pyrites is met with crystallized in some parts of the chalk rocks, and crystals of sulphate of barytes, have lately been discovered in the pits of fuller's earth near Reigate in Surrey. Fuller's earth, also, is peculiar to the strata under chalk. The iron-stone, which is found in part of this district, is not so rich as to bear the expense of bringing fuel from a distance to smelt it. The bones of quadrupeds, already mentioned, are never found in the strata below the chalk, but always in the clay over the chalk.

The middle district of England, in a mineralogical and geological point of view, which is bounded on the east by the calcareaeous range that extends from Dorsetshire to Yorkshire; and on the west from Northumberland to Derbyshire, by the metamorphic limestone mountains of the northern alpine district, or by mountains of millstone grit, resting upon limestone, consists of argaliceous and silicious sandstone. The secondary strata of this district extend west, till they touch the Irish sea, on the coast of Lancashire; or, farther south, are bounded by the alpine districts of Wales and Devonshire. The strata here are very irregular, hills of transition and basaltic rocks rising through them, and branches from the mountains of Wales, shooting, as it were, into this district, especially in Shropshire, and in a line extending from that county to the hills of Charnwood forest in Leicestershire. Basalt, or whinstone, also appears in this district, in the eastern moorlands of Yorkshire, which forms the highest part of it: the sides of the hills composing these moorlands, are covered with a bed of aluminous schistus, upwards of 100 yards in thickness; this schistus forms cliffs, extending in a waving line along the coast near Whithby: above it lie vegetable soils of various thickness: loose stone or rubble of uncertain thickness: coal from four to eight inches thick: compact iron stone, 24 inches thick, and broken iron stone five inches thick.

The principal coal fields, in the northern part of this district, lie in Northumberland and Durham, the west riding of Yorkshire, and Derbyshire: the strata of coal terminate a few miles to the north-east of the town of Derby, but make their appearance again to the south of the Trent in Leicestershire, near Ashby de la Zouch: on the south-east, they terminate at the Charnwood hills; while, on the south-west, a thick bed of coarse breccia and gravel, separate them from the coal fields in the county of Warwick. A considerable part of the western side of the middle district, from the southern division of Lancashire to Somersetshire, is occupied by a red sand rock: which extends through part of the counties of Lancashire, Cheshire, Staffordshire, Shropshire, and Worcestershire: the southern extremity of this rock, in Shropshire, rests on a highly elevated strata of grey wacke; and it is probable that it rests, through its whole extent, on transition rocks. No coal is found under the sand rock, and it seems to cut off the coal fields, which lie near, or upon it: it occurs at a very low comparative elevation. The principal salt springs, and the rock salt of Cheshire, are near, or on the red sand rock, in the vicinity of a range of lofty hills, which extend from the high peak in Derbyshire to Brown's Grove Lickey in Worcestershire. Near Northwich, in Cheshire,
the upper bed of rock salt lies 42 yards below the surface, and is 26 yards thick: it is separated from the lower bed by a stratum of argillaceous stone 10 yards thick; the lower bed has been penetrated to the depth of 40 yards; its breadth is 1400 yards, and, in one direction, it has been ascertained to extend 1½ mile. Three other beds of rock-salt have been found in another part of the county: the uppermost four feet; the second 12 feet thick; the third has been sunk to 25 yards. Brine springs are likewise met with at Droitwich in Worcestershire, in the midst of a similar red sand-stone. The strata here are as follows: from the surface mould, five feet; marl, 35 feet; gypsum, 40 feet; then a river of brine 22 inches; afterwards gypsum again; and below this, a rock of salt, into which the workmen have bored five feet.

Although, as we have already remarked, the red sandstone rock cuts off the coal fields in general, yet in some parts of Lancashire and the western counties, detached coal fields are surrounded by it. The greatest quantities of coal, however, in this district, are in Staffordshire, and that part of South Wales that borders on the Bristol Channel: all the strata of coal and iron stone in South Wales, are deposited in a limestone basin, the form of which is an irregular oval; in length 100 miles, and its breadth from 15 to 20; its greatest breadth is in the counties of Monmouth, Glamorgan, Caermarthen, and Brecon: in Pembroke-shire it is not more than five miles broad. The deepest line in this basin is between Neath in Glamorganshire, and Llanelli in Caermarthenshire: the uppermost stratum of coal is found here; the utmost depth of this stratum does not exceed 50 or 60 fathoms. The succeeding strata of coal lie deeper, and are accompanied with parallel strata of iron ore: the lowest strata at the centre range are from 600 to 700 fathoms deep. In this basin there are 12 strata of coal, from three to nine feet thick, and eleven others from 18 inches to three feet, making in all 95 feet. The limestone that forms the substratum of this mineral deposition, appears to the surface all along the boundary of the basin, and is supposed to have an underground connection from point to point.

As we approach the south-western counties, the middle district becomes very narrow, the calcareous strata of the low district approaching near the primary and transition rocks.

The alpine district of England and Wales is formed by an assemblage of lofty mountains, which pass along the western side of the island; the eastern side of the northern range of these mountains, from Cumberland to Derbyshire, is composed of subcrystalline metamorphic limestone, which in many parts is covered with the millstone grit, and shale grit, that have been already described. In the south-west part of Yorkshire, the limestone, for more than 20 miles, is covered by the incumbent grits; the mountains of Craven again exhibit it; and it rests on slate in Swaledale, at the base of Ingleborough and in other parts adjoining Westmoreland. The mountains of this county and Cumberland are composed principally of grey wacke, flinty slate, roof stone, and porphyry; a low range of granite rock rises near Shap in Westmoreland, and marble is found in different parts of this county. In this part of the northern range, ores of lead, copper, and zinc, are found: in some parts of Craven, carbonate of lead and galena are raised. The north-west of Lancashire, which comprises that district called Furness, consists for the most part of coarse slate and grey wacke; red hematite, a very rich and valuable iron ore, is procured in great abundance in this part of the country, particularly between Ulverstone and Furness Abbey. The southern part of this range consists of the rocks of Derbyshire: these consist of limestone and basaltic amygdaloid: it is supposed that the former rests on slate; there are here three beds of limestone, the depth of which and the basaltic amygdaloid, is upwards of 250 yards; in some parts a fourth bed of limestone is found, thicker than any of the others. The total depth of all the known Derbyshire strata, including the small portion of Nottinghamshire, which contain the magnesian limestone, is 1310 yards. In this range there are 50 beds of coal, varying in thickness from six inches to 11 feet: the total thickness of coal is 26 yards. Hence it appears, that as the thickness of the strata of the low district, (as has been already observed,) is about 700 yards, we must sink 1300 yards deeper, to arrive at the limestone incumbent on slate rocks, the depth of which, below the stratum of clay, in the valley of the Thames, must consequently be about a mile and a quarter.

As we approach the alpine district on the west side of England, rocks of a similar class to those in Wales are met with, but surrounded by the secondary strata of the middle district: the most considerable of these are the Malvern hills, and the Caradoc hills in Shropshire. According to Mr Horner, the central parts of the former are principally composed of granitic rock, mixed with hornblende: the lower deccivities are covered with limestone and sandstone. The Caradoc and Wrekin hills are composed of a variety of green stone; some of them contain actynolite: on the sides of these hills are singular beds of claystone, containing cells, flattened as if by pressure since their formation.

The mountains, on the eastern side of North Wales, are composed of limestone, containing lead and zinc. The limestone is similar to that of the northern range; detached coal fields are met with on their lower deccivities, in Flintshire and Denbighshire. The limestone rests on slate, which, as we proceed to the west, is seen rising from under it: in the same direction, mountains, principally composed of grey wacke, flinty slate, and roof slate, are found: veins of quartz, containing copper ore, also occur. Organic remains have been discovered in the slate of North Wales; it has not been ascertained that any true granite has been found here: in Anglesey there is serpentine, however, which, from its hardness, beauty, and tendency to a crystalline arrangement, may perhaps be regarded as a primary rock. Diaglage, intermixed with stannite, is found in two mountains, on the eastern side of Radnorshire. Rocks composed of cellular claystone, resembling lava, are met with on the west of these mountains, at Llandegley. The north side of Cader Idris, is covered with scattered basaltic columns; composed of porphyritic greenstone: this mountain contains silicious porphyry in mass, intersected by veins of quartz; silicious schistose porphyry, also intersected by veins of quartz; argillaceous porphyry in mass; and granite composed of quartz and schiorl in mass.

It has already been mentioned, that limestone is the foundation rock of the great coal formation in South Wales. The principal mineral treasures of the alpine districts of Wales, are copper, lead, and slate; and of the less elevated districts, coals and iron stone.

We shall now pass to the Devonian range of the al-
pine district. The strata of the middle district rise at an elevated angle, as they approach the granite rocks of this range. The western boundary of the coal district in Somersetshire is formed of metamorphic limestone and grey wacke, which pass from that county into Devonshire and Cornwall. Mountains of granite extend from Dartmoor to the Land's End. Slate, grey wacke, and sometimes metamorphic limestone, occur on their declivities and summits. At the Lizard, the granite rocks are covered with serpentine, near which diallage in rocks is found. In the serpentine also, soft slate is imbedded. The most extensive and valuable mineral treasures of this part of the alpine district are copper and tin; besides these, ores of silver, cobalt, bismuth, manganese, antimony, zinc, and iron are found. Indeed, it has been remarked, that all the 27 known metals are met with in Cornwall, except platinum, mercury, molybdenum, tellurium, tantalum, columbium, and cerium. In some of the granite rocks of Cornwall, school is found intermixed; and in some particular places, it constitutes the principal part of the rock.

Having given this general sketch of the mineral geography and geology of England and Wales, arranged into districts, we shall now proceed, in order more fully to illustrate this important subject, to offer some miscellaneous remarks, though at the risk of repeating some of the statements which have been already made.

To begin with the primary rocks. Granite and granitic rocks occur in Cornwall, Devonshire, North Wales, Anglesea, the Malvern Hills in Worcestershire, Charnwood Forest in Leicestershire, and in Cumberland and Westmorland. The granite of these two counties is, however, porphyritic; and that of Charnwood nearly allied to sienite. Blocks of granite are found detached in some parts of Lancashire and Cheshire. Gneiss is found nowhere in England, except at the Malvern Hills; and here it is imperfectly formed. Mica slate occurs only in Cornwall, where, along with it, lying over granite, serpentine, another primary rock, is also found, exclusively, with the exception of the Isle of Anglesea.

Of the intermediate or transition rocks, slate is found in Westmoreland, Yorkshire, Leicestershire, North Wales, Cornwall, and Devonshire. In the Yorkshire slate are cubic crystals of pyrites. In the slate rock at Charnwood Forest, in Leicestershire, the slaty laminae make an angle of 60 degrees with the principal seam, by which the rock is divided. Graywacke is met with in Cornwall, where it is called kilias. In the northern part of Radnorshire is a lofty range of mountains, composed of graywacke, which, on the eastern side, resembles sandstone, and on the western, roof-slate.

The compact limestone of England and Wales belongs properly to the transition rocks. In Yorkshire and the northern counties it rests on slate, and contains a greater quantity of organic remains than the Devonshire limestone. Trap, or greenstone, is met with in Cornwall in transition rocks; but it possesses no characters by which it can be distinguished from that found in primary rocks.

Transitions from granite to sienite and greenstone occur in the same block at Charnwood Forest. The two latter are also met with in Cornwall, Wales, and Cumberland. Amygdaloid, provincially called toadstone, is found in great abundance in Derbyshire. Porphyry occurs in the western side of England and Wales. It has already been mentioned, that porphyritic greenstone is scattered over the northern side of Cadre Idris. Basalt is found in Durham, Shropshire, &c.

The lowest of the secondary rocks in England is frequently a siliceous sandstone, coloured by red oxide of iron, and called red sandstone: this has been already described. The secondary rocks also include argillaceous sandstone, earthy limestone, calcareous sandstone, and chalk; and contain, besides the rock-salt, gypsum, iron-stone, coal, and basalt. On the eastern side of England, the coal strata generally decline to the south-east; on the western side, they are more frequently thrown into different directions, by faults and dikes. The deepest coal mines in England are those of Northumberland and Durham, some of which are wrought more than 800 yards below the surface. The thickest bed of English coal is in Staffordshire, which is 30 feet deep. In general, the beds of coal in other parts of England and Wales do not exceed from 6 to 9 feet in thickness. From the account which we have already given of the low district of England, it will be apparent, that there is more than one third of this country, in which all search for valuable coal is useless.

With respect to the upper secondary rocks, and the strata containing organic remains in England, there are magnesian limestone, chalk, flint, gypsum, the marl, and sand, over which, in many parts, contain a large quantity of red oxide of iron. Gypsum is principally found in Cheshire, Shropshire, Worcestershire, Derbyshire, and Nottinghamshire. In the gypsum of the two latter counties, no organic remains have been discovered. The organic remains found in the clay and gravel which covers the chalk in the southern counties, have already been noticed. The gravel over the clay is composed principally of flint, containing distinct impressions of unknown aquatic animals. Between the clay and the gravel there is sometimes a thin layer of fresh-water shells, which are also met with under the clay. In the strata over chalk, in the Isle of Wight, fresh-water shells have lately been detected.

If we were to cross England, from Hull into Lancashire, we should first meet with a flat country, formed of alluvial ground. A few miles to the west of this town, the land becomes more elevated, and we pass over a range of chalk hills, which consist of the southern extremity of the Yorkshire Wolds. After descending from these hills, near the Humber, we again enter on alluvial ground, covered with clay and gravel, which extends nearly to Ferrybridge. Here the magnesian limestone makes its appearance, which, with the earthy limestone, form hills of a low elevation, distinctly stratified. The strata are nearly horizontal, and divided by seams of clay. The extreme breadth of this range of hills is not more than three miles. Yellow silicious sandstone comes next, which is the boundary of the low calcareous district. Proceeding towards Wakefield, the argillaceous coal strata of the middle district, extending westward more than 20 miles, is met with. Wakefield and Leeds stand near the east side of the coal district, and Halifax and Huddersfield near the western. A few miles to the west of these towns, and also of Sheffield, hills, composed of millstone grit and shale grit, rise from under the coal strata. These are more than 300 yards thick; and no workable coal is ever found in them. The bases of these hills are metalliciferous. If we proceed still farther to the west toward Manchester, we descend the steep western declivities to the plains of Lancashire; and, lea-
statute.

The surface here in many parts is covered by beds of gravel; and in clay pits, under the surface, are found detached blocks of granite, basalt, scetnite, and slate, similar to the rocks in North Wales and Westmoreland. From the vicinity of Prescot to Liverpool, the immediate substratum is formed by the red rocks, which may be seen dipping under the waves of the Irish Sea.

If we had crossed the island, about 25 miles to the south of the direction we have just described, near the latitude of Sheffield and Chester, we should travel over nearly a similar series of rocks, except that beyond the vale of Derwent, 12 miles to the west of Sheffield, we should meet with the mettalliferous limestone of Derbyshire. The same mettalliferous limestone would also be met with, if, after crossing the red sandstone of Cheshire, we continued our line into Wales. Here it occurs in Flintshire, forming the boundary of the alpine district.

If we cross the island in the latitude of Lancaster, the mettalliferous limestone mountains of Craven, in Yorkshire, would be observed, rising from under the grit-stone, and resting upon slate. In this latitude, the grit-stone mountains of Wharfsdale approach near the earthy limestone on the eastern side, and nearly shut out the coal district.

In travelling from Kent to Cornwall, nearly 150 miles of chalk and calcareous sandstone, as far as the western district of Dorsetshire, are passed over. After we leave the chalk, a few miles of the lower secondary strata occur, before we arrive at the transition and primary rocks.

A brief notice of the principal mineral waters of England seems properly to belong to this part of our subject. They are thus classed by Dr Saunders: The simpler thermal, viz. Bristol, the temperature of which is 74°; Matlock, the temperature of which is 66°; and Buxton, with a temperature of 82°. The simple saline, of which Epsom is the principal: the simple carbonated chalybeate, of which Tunbridge is the principal: the hot carbonated chalybeate, or Bath waters, the temperature of which is 116°: the saline carbonated chalybeate, as the Cheltenham and Scarborough: the vitriolated chalybeate, as the Hartfell waters: and the cold sulphureous, as the Harrowgate. The waters of Malvern and Holywell seem to owe their medicinal virtues entirely to their purity.

CHAP. VI.

Agriculture.

Having thus fully considered, and, we trust, faithfully and accurately described England, as it came from the hands of nature, with respect to its climate, soil, and natural history, we shall now proceed to the second grand division of our subject; and consider and describe it, as it has been operated upon, by the exertion of the labour, and by the application of the science, the knowledge, the skill, and the capital of its inhabitants. From the sketch which we have given of its natural state, it will be seen, that while it presents no great obstacles, in any respect, to the successful exertion of human industry; on the other hand, it does not hold out what is requisite or desirable for the subsistence, comfort, or luxury of man, to be acquired by ease and indolence. To the man of enterprise and science, it is a valuable country, or may be made so; to the man of indolent habits and confined knowledge, existence in it could not be desirable.

This division of our subject naturally comprises several important branches. In the first place, the agriculture of the country; the leading principles on which it is practised; the more prominent particulars of the agricultural practice itself; and a comparative view of agricultural knowledge at present, and at former periods, claim our attention. In the second place, the mines and quarries, especially the former, as exhibiting evidences of the industry, ingenuity, and success of the people of this country, and as contributing to their defence, subsistence, power, and wealth, will be considered in an economical point of view, having been already treated of as branches of the natural history of England. In the third place, our manufactures, in which, more than in any other branch of human industry, England stands proudly pre-eminent over the rest of the world, will be considered at considerable length. It will easily be seen, that, under this head, we have no concern with the processes themselves of the different manufactures, except so far as a general description of some of them may contribute to point out and explain the great improvements which have from time to time made in manufactures. In treating on this subject, also, we shall intermix or premise historical notices, concerning the state of our principal manufactures at former periods. Neither our information, our limits, nor the nature and object of this article, will permit us to render these historical notices numerous, regular, or connected. What we have in view in giving them, is only to enable our readers to form some idea of the comparative state of our manufactures now and at former periods; and probably, in some instances, such historical notices may be important and interesting, as pointing out those changes in national manners and habits, which are sometimes indicated by the changes that take place in the manufactures for home use. In the fourth place, we shall consider the fisheries of England under their two natural and grand divisions; of the fisheries on our own coasts, or in our own rivers, and the fisheries which are carried on abroad, at Greenland and Davis’ Straits, in the South Seas, and off the coasts of Newfoundland. Lastly, the trade and commerce of England will claim our notice. The former divided into the inland and coasting trade; the latter embracing our mercantile connections with foreign nations. We are well aware of the extent and magnitude of this plan; of the importance, interest, and advantage, which would result from the complete and accurate execution of it; and of the extreme difficulty, and numerous obstacles, which lie in the way of such execution. Even if it were attempted by numerous individuals, each most judiciously and impartially selected for his information and knowledge in one particular branch, omissions and errors must appear; it must, therefore, be a matter of wonder or of certainty, if, in the present article, those who are conversant in any particular branch of the various and dissimilar subjects which are treated of, should detect omissions or errors.

SECT. 1. State and Management of Landed Property, Size and Rent of Farms, &c.

The natural and proper introduction to an account of the agriculture of England seems to be a description of

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of the state of landed property there; with this, therefore, we shall begin this division of our subject.

In England, landed property is tolerably well defined, and protected by the laws of the land. Through the various changes, however, that have taken place in our laws and constitution, in consequence of the conquests and revolutions to which the kingdom has been exposed, its landed property at present is of various descriptions; and the laws and regulations respecting it are almost without number.

The lands of property connected with the lands of England may be divided under two heads, namely, into possessory property, or the actual possession of the lands and their appurtenances; and into abstract rights arising out of them. Those who are inclined to trace the origin and decline of the ancient structure of English tenures, and to search for the fragments of them that are still in force, may consult Blackstone's Commentaries on the Laws and Constitution of England.

The first division of the species of property relating to the lands of England, or possessing property, comprises the soil or land itself; the minerals and fossils it covers; the waters annexed to it; the wood and herbage it produces; and the buildings, fences, &c. thereon erected. The other division of the species of property relating to the lands of England, or abstract rights, comprises seigniorial rights, as chief rents, &c.; manorial rights, as quit-rents, fines, &c.; prescriptive, or common rights; predial rights, or tithes; and parochial rights, or taxes. To these, advowson and parliamentary rights may be added, as they are not unfrequently attached to landed property.

It will be evident, from the consideration of these abstract rights, that possessory property in this country is further liable to analysis, and to more particular distinctions. In case lands are held unconditionally, and in full possession, without any other superior than the laws and constitution of the country, they are termed freehold. This term again admits of still further distinctions.

If the lands are liable to regular and fixed annual payments, which payments are beneath their annual value, and without being liable to fine, heriot, or forfeiture, they are freehold, or are comprised under the denomination of other inferior holding. When they are held of a superior, as part of a royalty, honour, or manor, and are liable to fines, on account of deaths, transfers, or other circumstances, they are copyhold.

Copyhold property is subject to the customs of the royalty, manor, or honour, of which it is a part.

Leasehold property is also of various descriptions and value in England; long leasehold, as for a thousand years; life leasehold, with a fine certain or under certain limitations on a renewal; life leasehold, with an uncertain fine, which is payable to the proprietor or other superior; in this case, he reserves merely a conventional rent; the tenant having paid down a sum of money to obtain the lease, and the right of alienation: this practice is common in the west of England. The conventional rents are reserved and exacted in these cases, in order that the proprietor of the lands may have the right of conveying the tenants to his court or audit, as well as to know which of his tenants are alive, in order that no fraud or overholding may take place. There is also another kind of life leasehold with an uncertain fine: this fine is payable to the proprietor, who receives the full rent of the land at the time of granting the lease; the lessee having a power of alienation; this is a common practice in Wales and in some parts of England. The last distinction of leasehold property, which exists in England, is leasehold for an ordinary term, with the power of alienation. These various rights of possession are styled tenures. Where a lease is granted, without the power of alienation or transfer, it is a species of holding, which merely gives the right of occupancy.

Legal possession of landed property is gained, by grant, as from the crown; by prescription, or long usage; by descent, as from an ancestor; by deed of gift or settlement; by the testament of the deceased owner; by forfeiture, as to a mortgage; and by purchase, either entered on a court roll, or ratified by a deed of conveyance.

In most parts of England, the tenures are nearly of the same kind; and landed property descends in the same manner; but nearly in the whole of Kent, and in some small portions of other counties, gavel-kind, or the equal distribution of landed property among all the sons of a family, prevails. In some parts also, another species of tenure prevails, which is that of borough English, by which the younger son succeeds to the land on the death of his father, to the exclusion of his eldest and other brothers.

Landed property varies in size and value very much. Size of estates.

In different parts of England, perhaps the largest income derived from land may amount to nearly L.100,000 per annum; but the general annual income arising from this kind of property is probably not more than one or two thousand a year. In some counties, particularly in the west of England, landed property is much divided: this is also the case in other parts of the kingdom; while in some counties, nearly the whole of the landed property is in the hands of a very few individuals. In Cheshire, the estates are perhaps more nearly of a size than in most other counties, running from L.5000 to L.15,000 a year. In the manufacturing districts, the small landed proprietors of L.200 or L.300 a year, have been driven away by the introduction of manufactures, and the high price of the necessaries of life, or have been induced to dispose of their property, by the great rise in the value of land in these parts.

The management of landed property in England is generally in the hands of stewards; in some cases, these are men practically conversant with the management and improvement of estates, but too often they are bred to the law, who are better acquainted with the legal language and formalities of a lease, than with the value of land, or the mode in which, for the advantage of the tenant, the landlord, and the community, it ought to be cultivated.

The size of farms varies very much, not only in different parts of the kingdom, but even in the same country. Farms of the extent of 500 to 1500 acres are deemed large farms. Those that are under 100 acres are considered small ones. The largest farms in England are to be met with in the northern parts of Northumberland, in Norfolk, Suffolk, Essex, Kent, and Dorsetshire; a few also occur in other counties; and in general it may be remarked, that farms are larger in the north, eastern, and south-eastern counties, than in the south-western, western, or north-western counties of England. In Wales, farms are for the most part very small.

The practice of letting land on lease is by no means common in England; and it is certainly on the decline. Where leases are granted, they are generally for 7 or 14 years; seldom for 21 years, or a longer period. Leases are most usual in those counties where farms
England.

are the largest. It has already been remarked, that life-leasehold is very common in the west of England, and also in Lancashire, Cheshire, &c. Where no leases are granted, the tenant either holds at will, the only tie between the owner and occupier being the custom of the estate or of the county in which it lies, and the common law of the land; or he holds from year to year, under a written agreement with specified covenants: this is a modern usage, but it is becoming more and more prevalent.

Where leases are granted in England, they are in general much clogged with restrictive clauses; so that the tenant is either under the necessity of carefully avoiding all attempts to improve his farm, by introducing new practices and courses of crops, or he exposes himself by deviations from the covenants of his lease, to the payment of those heavy fines which are specified in it.

When the advantages that the English agriculturist possesses, in respect to climate, are considered, it will probably be found that the rent, which he pays for land, is comparatively low. It is impossible to fix with accuracy the average rent, either of arable or of pasture land, throughout the kingdom; but we shall not be very wide of the truth, if we estimate the average of the two, together, at 20s. per acre. Perhaps, indeed, in the opinion of many, this may be reckoned too high, since the average of the county of Norfolk, which, though of inferior soil, is much better farmed, than most of the arable counties of England, is not above 16s. per acre; but, on the other hand, it should be considered, that most of the arable farms in the north of England, particularly in Northumberland, Durham, and Yorkshire, as well as in many of the arable counties in the south-east of England, as Essex, Kent, Hampshire, &c. are let much above 20s. per acre, and a very small proportion of the grass land is let at so low a rent as this. From communications made to the Board of Agriculture, it was ascertained, that the rise of rents in England between the year 1790 and 1804, was 39 per cent. and since that period a still farther rise has taken place, probably to the amount of 50 per cent. All the other expenses of cultivation have also increased, some of them in as great a proportion. The highest rents for arable land (subject to the payment of tithes, poor rates, &c.) in England, do not, perhaps, exceed 50s. unless where some peculiar and local advantages exist: much land, even of a moderately good quality, is let from 10s. to 12s. per acre. Pasture land varies from 20s. to L.3; and where it is of smaller extent, and occupied for local purposes, especially in some of the manufacturing counties, it is let as high as L.5, or L.6 per acre, or even higher.

The English farmer, besides the payment of his rent to his landlord, is subject to the payment, in most cases, of tithes and poor rates. The latter vary very much in different parishes, and even sometimes in the same parish, at different periods. The former are more steady and regular in their amount. Perhaps, together, they may amount to one half, or 3/5ths of the rent.

The ordinary term of entry to a farm in England is Lady-day; but Candlemas, Whit-sunday, and Michaelmas, are also common terms in some parts of the kingdom. Michaelmas and Lady day are the customary terms of payment; the first payment commences six months after entry to the possession of the farm. Letting lands for a term of years for a former rent, but making the farmer pay a considerable sum by way of fine, was formerly a very common custom, but it is now chiefly confined to the crown and church lands.

Sect. II. Agricultural Departments.

Having premised these general remarks, we shall now proceed to an account of the agriculture of England. This kingdom, not including Wales, in an agricultural point of view, may very properly be divided into six departments or districts: by an agricultural district, meaning that tract, which is distinguished from other parts of the kingdom, by a uniformity or similarity of practice, whether it be characterised by grazing, sheep-farming, arable management, or mixed cultivation; or by the production of some particular article, as dairy produce, fruit-liquor, &c. The six agricultural departments distinguished from one another in this point of view, are the northern, the western, the midland, the eastern, the southern, and the south-western.

The northern agricultural district includes the principal parts of Northumberland and Durham, the whole of Cumberland, Westmorland, Lancashire, and York- shire, (excluding the Pennines and marshy land bordering on Lincolnshire,) with parts of Cheshire, Staffordshire, and Derbyshire. This department is distinguished by a coolness of climate, and a backwardness of seasons, as compared with the more southern parts of the island; but its most striking natural feature is derived from its mountains. As a field of rural economy, it is also strongly distinguished from the other agricultural districts. On its western side, manufactures indeed, have prevailed over agriculture; but on its eastern side, all the branches of the latter flourish. It would not, indeed, be easy to point out any portion of the kingdom, in which a greater degree of agricultural skill and industry is displayed, than in the northern parts of Northumberland, and on the banks of the Tyne.

The western department extends from the Mersey to the banks of the Somersetshire Avon; being bounded on the west, by the Welsh mountains; on the east, by the lower hills of Staffordshire, and the uplands of Warwickshire and Oxfordshire, and on the south, by the chalk hills of Wiltshire, and the Sedgemoors of Somersetshire. Nearly the whole of this agricultural department, comprises an uninterrupted succession of vale districts, formed by the passage of the Severn, the Avon, the Dee, and the Mersey, to the sea. It is no less distinctly marked by agricultural produce, as the whole of it, with the exception of the high lands of Shropshire and Herefordshire, the Cotswold hills in Gloucestershire, and the Mendip hills in Somersetshire, may be almost said to be applied to the produce of the dairy. It is also distinguished as an agricultural district, by its fruit-liquor.

The midland department is bounded by the mountains of the northern, and the chalk hills of the southern departments, in its length; and by the rising grounds, which separate it from the western department, and the banks of the marshes, where the eastern department commences, in its breadth. Compared with the great variety of soil and surface, exhibited by the other departments, this may be regarded as one widely extended plain of fertile lands, without a single eminence, except the Charnwood hills. In its agricultural character, it is distinguished by its mixed cultivation, to which the nature of its soil and surface is almost uniformly suitable. As a wide field of agriculture, (to use the words of Mr. Marshall,) in which every
branch of the profession is highly cultivated, it has been long popularly known. Here not only the spirit of improvement, but of enterprize, may be said to inhabit. The art, science, and mystery of breeding has here been carried to a height, which in any other country probably it has never attained;—the same enterprising spirit, which led to this pre-eminence, still continuing, with little or any abatement.

The eastern department is not more strongly marked in its natural, than in its agricultural character; in the former, its fens and marshes, as well as the light sandy quality of its uplands, features that are united in no other district of the kingdom, mark it out; in the latter, the turnip husbandry is the most distinguishing feature. The agricultural pursuits of the eastern department, are directed, in a principal manner, to grazing, not only in the marshes and lower grounds, but on the uplands. Sheep, as well as cattle, are grazed here; and it may also be remarked, that in a very considerable portion of this agricultural district, arable husbandry is very extensively and intimately connected with the fattening of sheep and cattle. Its boundaries are distinctly marked, including the fen lands of Lincolnshire, Northamptonshire, Cambridgeshire, Huntingdonshire, and Norfolk, as well as the rest of Norfolk, and the counties of Suffolk in Essex, with those parts of the adjoining counties which lie close to them.

The southern department, which includes the chalk hills in the vicinity of the metropolis, as well as those in the more remote counties, is, by the circumstance of these hills, distinctly marked out, in its natural character, from the rest of the kingdom. That part of it which lies in the more immediate vicinity of the metropolis, is, of course, directed, in the nature and objects of its husbandry, by the demands created by the metropolis; and thus an artificial character is, as it were, given to its agricultural pursuits. The other part of this district is distinguished by its flocks of sheep, which are fed on its chalk hills; the breeds, and mode of management, of which are very different from those in the midland and eastern departments.

The natural situation of the last, or south-western agricultural department, is very remarkable; it stretches away from the main body of the island, in a peninsular form, into the western sea. This peninsula is nearly 200 miles long, and is bounded by that sea, except where it touches the southern and western departments. The natural characters of its area, as well as of its situation, are also singular. Slate rock hills, which are comparatively unknown in the rest of the kingdom, except in a small portion of the northern department, here abound. The surface, indeed, almost throughout the department, (its north-eastern angle excepted,) is of a singular character, consisting of bare steepled sides, separated by narrow valleys: the hills, in general, are productive to their very summits. In its agricultural character and pursuits, it is not less remarkable; the husbandry that is carried on there being more nearly allied to the ancient husbandry of the Romans, than any pursued in this island. Arable, as well as pasture and dairy husbandry, are indeed pursued, but the mode of uniting them, the practices which prevail in each, and the grand features of the whole, are remarkable, and strongly distinguished.

Notwithstanding this general division of the kingdom into agricultural departments, it may be proper to specify the counties which are principally occupied in the three great branches of agricultural industry, followed in England, namely, arable husbandry; dairy husbandry; and that husbandry which is directed to the breeding and fattening of cattle and sheep.

The following are the principal counties in which arable husbandry is pursued to a greater extent than in the other parts of the kingdom: Kent, Essex, Suffolks, Norfolk, Hampshire, Berkshire, Bedfordshire, Surrey, Sussex, Hertfordshire, part of Yorkshire, Durham, and Northumberland. The dairy counties, either for butter or cheese, or both, are Cheshire, Shropshire, Gloucestershire, Wiltshire, Buckinghamshire, Essex, Suffolk, Yorkshire, Derbyshire, Cambridgeshire, Dorsetshire, and Devonshire. The counties most distinguished for breeding and fattening cattle and sheep are Lincolnshire, Somersetshire, Leicestershire, Northamptonshire, Teeswater in Durham, and Cleveland and Holderness in Yorkshire.

It will be evident, however, that in this arrangement, many counties must be specified, in which more than one of the three great agricultural pursuits are carried on; and it may be remarked, that the arable husbandry, in some counties, is closely connected with the fattening of sheep, but seldom with the dairy husbandry; while the latter is often connected with the breeding and fattening of cattle and sheep.

Sect. III. Arable Husbandry.

In giving a general sketch of the arable husbandry of England, it will be proper to consider it under two heads, namely, the instruments employed in carrying it on, and the crops cultivated. On the first head, our remarks must be brief, since it would lead us far beyond our limits to particularise or describe nearly all the agricultural implements used in England.

The ploughs employed are of various and numerous sorts, but they may be divided into three principal classes: the swing-plough, the wheel-plough, and the turn-wrest plough: the first seems to be the oldest plough in England, at least in its original construction: it is for the most part a heavy ill made implement. In its original form, it is not however now often met with; but in its improved construction, it is general in the northern, north-western, and some of the midland counties: in Suffolk, a peculiar kind of swing-plough is used. Ploughs with one or two wheels are common in the southern, and south-western counties of England, as well as in some of the midland counties: a peculiar plough of this construction is almost exclusively seen in Norfolk. Turn-wrest ploughs are general over Kent, and on the chalk hills of Sussex and Hertfordshire: they are not common in other parts of the kingdom. Besides these three kinds, double moulded ploughs are used; but their use is by no means general, nor is it likely to continue. On the whole, it may be remarked, that the ploughs, as well as most of the other agricultural implements in England, are by no means constructed on those scientific principles, and with that skill which enables them to do their work well with the least expence of labour and time.

Perhaps the imperfect construction of the ploughs may be one cause why in England a greater number of horses than necessary are employed in them. If we except the counties of Norfolk, Suffolk, and Essex, in the south of England, and those of Northumberland, Durham, Cumberland, and Westmoreland, in the north, there is perhaps no other county in which more than two horses will not be seen in a plough. In some counties, the practice of ploughing with two horses is never followed, even on the lightest soils; and it may in general be remarked of the south, south-eastern and

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**Statistics.**

- **Principal arable counties.**
- **Dairy counties.**
- **Breeding counties.**

**Plotugs,** &c.

**Number of horses in a plough.**
Few of the other implements of agriculture used in
England require particular notice; they are very num-
erous; almost constant changes are making in them;
but simplicity of principle and construction are too
little attended to. With the exception of the northern
counties, waggons are almost universally used in hus-
bandry, as well as carts. In the northern counties, on
the contrary, waggons are seldom seen in the occupa-
tion of a farmer. The thrashing machine is now pret-
ty common, in most parts of the kingdom, but it is only
within these very few years that it has been introduced
into the midland and southern counties: though the
minutiae of its construction vary considerably, yet in
almost every case it operates by beating, not rubbing
out the grain.

Before agricultural improvements began in England,
there appears to have been little or no fallow land: one
of the first, or at least one of the most striking and im-
portant improvements in its agriculture, was the intro-
duction of fallows: they are very common on most of
the strong and wet lands in the arable districts, though
attempts have been made, especially in the southern
counties, which are favoured with a long and dry sum-
mer, to do without them. On the light dry soils, in
every almost part of the kingdom, they have been en-
tirely superseded by the introduction of turnips and
other green crops.

The courses of crops commonly cultivated vary very
much, not only according to the nature of the soil and
climate, but even with the same soil and climate. In
the best farmed counties, which may justly be con-
dered to be Norfolk, Suffolk, Kent, and Northumber-
land, a general principle is laid down, not to sow two
white crops in succession: this principle is gradually
extending itself, and is acted upon by the best farmers
in all parts of the kingdom. It is, however, still ne-
eglected by too many; and oats or barley after wheat,
after oats, and two or three crops of oats in suc-
cession, are by no means uncommon. On light soils,
the most judicious rotation, and that which is pursued
by the most intelligent and successful agriculturists, is
borrowed from the county of Norfolk, and thence cal-
ded the Norfolk system: it consists of turnips, barley,
clover, and wheat. On heavy soils, no one rotation
is nearly so common as this is on light soils. Those
most pursued are fallow, wheat, beans, oats: fallow,
wheat, oats: fallow, wheat, clover, beans, oats. Bar-
ley is not often introduced into the rotations on strong
lands; and tares or cabbages are sometimes substituted
for fallow. In the Isle of Sheppey, in Kent, and in a few
other spots of uncommon fertility, wheat and beans are
grown, without the intervention either of a fallow or
any other crop.

Besides these rotations, in the course of which the
ground is constantly under the plough, there are other
rotations founded on the principles of what is called
the convertible husbandry. According to the prin-
ciples of this husbandry, the ground, after being laid
down for three, five, or more years, to grass, is bro-
ken up, and sown with different species of corn for
some years, after which it is again laid down to grass.
This mode of husbandry is making its way into the
best farmed districts of England, so that more grass-
land, (not permanent, but for a few years), is seen in
the districts, strictly speaking arable, than was former-
ly kept; and a greater breadth of ground is under the
plough, in many of those counties, which formerly
were almost exclusively under grass.

Wheat is by far the most important, and the most
tightly cultivated crop in England: from what has
been already said, it will appear that it is sown after
clover, fallow, tares, and cabbages: it is also sown
after beans and potatoes, but never in the best farmed
districts of England after any white crop. As it is a
crop on which the farmer mainly depends, the prepa-
ration for it, in whatever rotation it comes, is managed
with great labour and attention. If it is to be sown
after fallow, the land is ploughed and harrowed re-
peatedly, and well manured. After one ploughing is given, and seldom more after beans; where
tares have been previously sown, they are got off the
land in sufficient time to plough it more than once for
the succeeding crop of wheat. The drill husbandry,
with respect to this crop, is by no means common in
England; and it is still less frequently put in with the
dibble, by far the greatest proportion being sown broad-
cast.

The usual quantity of seed to an acre is from 2 to 3 bushels. The kinds of wheat sown are very
numerous, but they may be classed under four heads:
concealed or bearded wheat, which however is now little
sown; white wheat, of which the varieties are almost
numberless; red wheat, which is seldom sown where
the climate is very good and early, and the land in
high condition; and spring wheat. The last, in con-
sequence of the high price of wheat, and the desire
which this naturally produces in the farmer to sow
wheat after his turnips in the spring, is becoming more
common, though the real spring wheat is of compar-
atively late introduction. Wheat is seldom sown before
the beginning or middle of September in any part of
England, and seldom so late as the end of April: the
most usual period is between the middle of October and
the end of the year. While growing, not much atten-
tion or labour are bestowed upon it, unless where it is
drilled, in which case it is hoed: where sown broadcast,
it is sometimes rolled and harrowed in the spring. The
wheat harvest commences in the south of England about
the end of July, or the beginning of August; in the
midland counties it is about 10 days later; in the
northern counties, nearly three weeks. There is a stri-
kng difference in the harvest field in respect to this, as well as other kinds of grain, in the
north and in the south of England; in the former, du-
ring harvest, the corn field exhibits a large num-
ber of reapers, perhaps 50, 60, or even 100, all pro-
ceding in their operations together, and presenting
an interesting and animating picture. In the south of
England, and indeed over the greater part of the mid-
land counties, on the contrary, wheat is cut down by
two or three individuals, each of whom contracts to
cut a field, or a certain number of acres. The wheat
field consequently exhibits merely one or two men, per-
haps, with their wives, working in different parts of
it. Wheat is seldom or never cut down with the
cythe, but is either reaped with the common sickle, or,
as is the practice in some of the counties near the
metropolis, as well as in some of the south western coun-
ties, it is bagged, that is, struck down near the ground
with a large and heavy hook. It is universally bound
in sheaves. Perhaps no circumstance marks the dis-
ference of climate in the south and north of England
more strongly, than the difference in point of time du-
ring which it is necessary to keep wheat and other grain
in the field before it is taken home. In the southern
counties, it is generally ready in a week or ten days;
whereas, in the north of England, it is necessary to
let it stand out for two or three weeks. In the south-
erm and midland counties, it is frequently put into
barrels: in the northern counties, it is almost universal-
ly stacked. As this grain is so very extensively cul-
tivated, and consequently on much inferior soil, and
frequently after very imperfect preparation, the produce
per acre varies very considerably in different counties:
as it is also very liable in this climate to be injured by
a bad seed-time, a wet winter, or a blight during the
period of its flowering (which last is here the common
cause of the failure or deficiency of our wheat crop)
its produce varies as much in different seasons in the
same part of England, and under the same manage-
ment, as it does during the same season in different
parts of the kingdom. The lowest quantity of pro-
due, except where an absolute deficiency from blight
occurs, may perhaps be rated at 12 bushels per acre;
the highest at six or seven quarters. The latter have
been reaped on the deep loams near Chichester in
Sussex, on the calcareous loams near Epsom, and in
some of the more favoured and highly cultivated spots
of Kent, Essex, Lincolnshire, and Somerset. A
tabular view of the average produce of the different
counties of England and Wales, in wheat, barley, oats,
&c. will afterwards be given.

The wheat counties of England are Kent, Essex,
Suffolk, Rutland, Hertfordshire, Berkshire, Hampshire,
and Herefordshire; that is, these are most distinguis-
ished for the quantity, as well as the quality, of their
wheat. In the north of England, this grain is of an
inferior quality, being cold to the feel, dark coloured,
thick skinned, and yielding comparatively little flour.
In the best wheat counties, and in good years, the
weight of a bushel of wheat, eight gallons to the bushel,
is from 60 to 62 lbs. In the Isle of Shepey, in Kent,
(where perhaps the best samples of wheat sent to the
London market are produced), this grain, in some fa-
vourable seasons, weighs 64 lbs. the bushel. Where
the climate is naturally colder, wetter, and more back-
ward, or in bad seasons, the weight of the bushel of
wheat is not more than 56 or 57 lbs. It is calculat-
ed that the average weight of the bushel of good En-
lish wheat is 58 lbs., yielding 344 lbs. of flour for stan-
dard wheaten bread; and 573 lbs. for household. Se-
ven bushels of good wheat will make a sack of wheaten
flour.

The culture of rye, which was formerly pretty ex-
tensive in some parts of England, has now nearly en-
tirely disappeared. This has arisen from the operation
of two causes. In the first place, greater experience
and improved skill, have convinced the farmers that a
very large proportion of very light land, which was
deemed fit only for rye, may, by proper management
and due labour and expence, be rendered capable of
producing valuable crops of wheat; and, in the second
place, the increased wages of the labouring classes of the
community has naturally led them to a preference of
wheat bread to bread of any other description. Rye,
however, is still cultivated in some parts of North-
umberland and Durham, either by itself, or along with
wheat; and in the vicinity of the metropolis. In no
other part is it cultivated to any extent for seed: but
it is grown in many counties as green food for cattle,
coming early in the spring to maturity for this purpose,
and afterwards allowing time for a subsequent crop the
same year.

The culture of barley is also on the decline in most Bar-
ley. parts of England, owing, of course, to a diminished
demand for it, and to the increasing demand for wheat,
and consequent high price of this latter grain. The
diminished demand for barley arises from the same
cause which has produced a diminished demand for
rye, namely, the increased wages of the labouring classes,
in conjunction with another cause, the stoppage of
distillation from this grain, which has frequently taken
place in late years. These two causes would probably
have diminished the growth of barley to a still greater
extent than they have done, were it not for its impor-
tance as a crop in the rotation most adapted and bene-
cicial to light lands. The barley counties of England
are principally Norfolk, Suffolk, Cambridgeshire, Bed-
fordshire, Leicestershire, Nottinghamshire, and the upper
parts of Herefordshire, Warwickshire, Shropshire.
The most common preparation for this crop, where its
culture is best understood, and most extensively followed,
is turnips: after these are drawn or eaten off, the land
is ploughed two or three times, and harrowed repe-
tedly. The season for sowing barley extends from the
middle of March to the end of April. It is more
generally drilled than wheat, but this mode of culture is
by no means common; when followed, about two bu-
shels of seed are sown; in the broadcast method, three
or 3¼ bushels. There are two leading varieties of this
grain grown; the common barley, of which there are
several kinds, and big; the latter, however, is almost
totally confined to the lofty parts of the northern
counties. The barley harvest, in the south of Eng-
land, commences nearly about the same time as the
wheat harvest, perhaps a little later: in the north, it
is often cut down before the wheat. The practice of
mowing it, which has long been followed in the south,
is becoming general; but the carrying it home in a
loose state, without being bound into sheaves, is con-
fined to the southern counties, and indeed can only be
practised there with safety, where the climate is so
warm and steady as frequently to render it fit to be
carried to the barn-yard in the course of a few days.
It is seldom housed in any part of England. The pro-
duce varies from three to eight quarters: the most
usual crop is 3½ or 4 quarters: the usual weight of a
bushel of barley is 50 lbs.; the best Norfolk barley,
however, sometimes weighs 55 lbs. This crop is grown
in some places after peas and tares, as well as after
turnips; and where it is sown on strong land, a sum-
mer fallow preparation is sometimes given. The prac-
tice of sowing it after wheat or oats is on the de-
cline.

In consequence of the increased number of horses Oats
kept in England for business or pleasure, within these
few years, the cultivation of oats has been considerably
extended. As, however, they do not suit so well with
a warm and early climate, as with a climate more moist
and backward, the crops of them in the former being
never so abundant nor of such good quality as in the
latter: the cultivation of oats is more attended to in
the north of England and Wales, than in the southern
counties. The counties in which they are most ex-
tensively grown, are Northumberland, Durham, Cumber-
land, Westmoreland, Lancashire; and the fens of Lin-
There are four leading varieties of this grain cultivated in England: the white, the black, the grey, and the brown or red; of the white, the subvarieties are very numerous; but the most common are the common white, the Tartarian, the Dutch, the Polish, and the potato oat: the black and grey are little cultivated: the red is confined principally to Cheshire, Derbyshire, and Staffordshire. Besides these kinds, a species of naked oats, called provincially pillar, are grown in Cornwall.

Oats are almost always, in every part of the kingdom, the first crop after the breaking up of old grass land. They are also sown generally on strong land, after clover ley; and in the north of England, they succeed clover on most kinds of soil. Besides coming in this rotation, they are sown sometimes after turnips; and where the husbandry is bad, they are taken as the last crop before fallow, even when the ground is dirty and exhausted. In the southern counties of England, the end of February, and in the midland and northern counties, the middle or end of March is the usual seed-time. They are very seldom drilled. The usual quantity of seed to the acre is five bushels. Perhaps the produce of no species of grain varies more than that of oats. Where the ground is foul and exhausted, not more than 20 bushels are obtained; but on rich soil well managed, eight, nine, and sometimes ten quarters, have been produced. In most parts of England they are mown, except when the crop is very strong. They are generally, but not always, carried loose into the barn-yard, where they are put up in stacks.

Beans are grown on almost all the strong lands of the kingdom, which are under the plough; and their cultivation probably has not extended, as, according to the old rotation pursued when most of the land was in common fields, they, preceded by wheat and followed by fallow, formed the whole course of the husbandry of our ancestors. But though their cultivation is very general, there are few counties in which it is well conducted. Perhaps Gloucestershire in the west of England, and Kent and Essex in the south, may be pointed out, as the counties where the culture of this plant is conducted with the greatest judgment, skill, and success. In these and some other counties, they are planted in rows or clusters, and carefully weeded, both by the horse-hoe and the hand. They are generally grown after wheat, oats, or clover ley; and are put into the ground as soon in the spring as the weather will permit. The bean harvest, in every part of the kingdom, is late, generally ten days or a fortnight after all the white corn is cut down. The produce varies from 16 to 40 bushels. Pease are very little cultivated in any part of the kingdom, except in the vicinity of the metropolis, as a garden crop. Where grown as a farm crop, they generally succeed clover ley, wheat, barley, or oats. The produce, in consequence of the unsettled nature of our climate, is very uncertain and various.

Tares are principally grown as spring food for sheep, cattle, or horses. In the south of England, there are two kinds: the winter and spring. The former, sown in the autumn, is ready to cut in the month of April or May; but this kind does not come to perfection in the northern counties. The latter kind is sown in March and is cut in the autumn. Buck-wheat is seldom seen in England. A little of it is cultivated in Norfolk and some other counties, where the soil is light and poor, and permitted to remain till it is ripe; in other parts, it is sown and ploughed down, as a winter, white. There are three kinds of clover, red, Dutch, and yellow clover, or trefoil, are very generally grown, but to a greater extent, and with more success in the eastern, southern, and northern counties, than in the western or midland. The cultivation of red clover after barley, and as a preparation for wheat, is considered as one of the proofs of superior husbandry, in those districts where it is extensively and regularly sown in this rotation. In the north of England, rye-grass is commonly sown along with clover, where hay is the object; but in the south, and particularly in the vicinity of the metropolis, clover is sown alone. Dutch or white clover is used principally in laying down land to grass. Sainfoin not thriving well, except where the soil or subsoil is calcareous, is not met with generally. On the Cotswold hills, and on the chalk soils of Dorsetshire, Hampshire, Wiltshire, Hertfordshire, Surrey, Sussex, and Kent, it is extensively cultivated. It generally remains for eight or ten years; a much longer period, according to A. Young, than it is found to do in France. It is made into hay, and the after crop eaten by sheep or cattle. Lucerne, nearly allied to sainfoin in its character, habits, and properties, is not grown to any extent, except in some districts of Sussex and Kent.

The counties into which the culture and use of that valuable root, the potato, was first introduced, and in which it is still grown in the greatest perfection, are Lancashire and Cheshire: in the former, about Altrincham, and in the latter, about Frodsham. Potatoes are also grown to a considerable extent in Yorkshire, particularly on the warland, or the soil on which the sediment of the river is permitted to be deposited, Cumberland, and Cornwall. Their cultivation and use, however, are less extensive and common in the western counties, than in any other part of the kingdom. On the light soils in the low parts of Wales, they are commonly grown. They are planted in the months of April and May, generally in rows; horse-hoed and weeded by the hand while growing, and taken up in the month of October, either by the plough, or by a particular kind of fork. The produce varies from six to ten tons. They are used as a preparation for wheat, instead of a fallow. In Lancashire and Cheshire, however, they are planted on lands broken up from grass for the purpose.

The county of Norfolk was, for a long time, almost exclusively remarkable for the great breadth of turnips sown in it, and for the judgment, skill, and success, with which they were cultivated; but at present this most useful and valuable root is grown in almost every county in England, in a greater or less degree. In a superior manner, however, and to a greater extent in Norfolk and Northumberland, than in any other counties. Perhaps there are fewer turnips grown in Cheshire and Lancashire, in the north-west, and in some of the south-western counties, than elsewhere. In the north part of Northumberland, they are almost universally drilled. The drill husbandry is also used with respect to them partially in other places; but by far the most common mode of sowing them, is broadcast. They seldom suc-
Flax and hemp.

and extend the cultivation of flax and hemp; but the bounties were soon withdrawn, it is said, because they indirectly went to the landlords instead of the tenants, the former expecting an increased rent for their land, in proportion to the bounties given. However this may be, flax and hemp are by no means extensively cultivated in England; chiefly between Bridport and Beaminster in Dorsetshire, about Frome, Crewkerne, &c. in Somersetshire; at Upwell and Chatteris in the Isle of Ely, in some parts of Lincolnshire, and on the strong lands of High Suffolk.

England has long been noted for its hops. They are grown cultivated in the neighbourhood of Canterbury and Maidstone in Kent, where there is a larger extent of ground under this crop than in any other county in the kingdom: about Farnham in Surrey, and the adjoining parts of Hampshire, where, from superior management, or other causes, their quality is so highly esteemed, that they always bring a much higher price than any other hops: in Worcestershire, particularly in the vale of the Severn and in the vale of the Team; in the vicinity of Stow market in Suffolk, and near Retford in Nottinghamshire; but in these two places only, to a very inconsiderable extent: in Herefordshire, particularly on the confines of Worcestershire: in Essex, about Castle Hedingham: and in some parts of Sussex. This crop is so much affected by the climate, and so much exposed to blights and other distempers, that its produce varies more perhaps than that of any other plant cultivated in the fields. This will sufficiently appear, from the following statement of the produce of hops in England during the years $1795$ and $1796$.

In the former year, it amounted only to 5,000,000 lbs., whereas in 1796, the produce was 42,528,587 lbs. The average, ascertained from the produce of a considerable number of years, is found to be 20,543,070 lbs. Hop grounds let at a higher rate per acre than any other kind of land not possessed of peculiar local advantages, bringing from L5 to L10 per acre; and about Farnham, considerably more.

There is scarcely a farm of any extent in the southern and south-western counties, which has not an orchard attached to it, containing apple trees at least sufficiently numerous and productive to supply the farmer's family with cider; but it is exclusively or principally in the counties of Devonshire, Herefordshire, Worcestershire, Gloucestershire, Monmouthshire, and Somersetshire, that cider and perry are made in very large quantities for sale; and where the management of the orchards forms principally or exclusively the concern of the farmer. Perry is made chiefly in Worcestershire; and the cider of Herefordshire and Gloucestershire is deemed of a superior quality to that of Devonshire. The actual quantity of cider made in the cider counties has not been ascertained. Mr. Marshall calculates that the produce of the four counties of Worcester, Gloucester, Hereford, and Monmouth, on a par of years, may be laid at 30,000 hogsheads; of this quantity it is supposed Worcestershire supplies nearly 10,000 hogsheads, besides 1000 hogsheads of perry. Exclusively of these liquors, which are sent into all parts of the kingdom, these counties, which may be considered the principal fruit counties of England, send large quantities of fruit chiefly into the northern counties. The average tonnage of fruit sent out of Worcestershire alone, by the canals, into the north, for three years, amounted to 1500 tons; and in one year it exceeded 2000 tons. The county of Kent is famous for orchards of another description from those of the western counties. These...
are orchards of cherries and filberts. The former are common in most parts of Kent; the latter are principally confined to the vicinity of Maidstone, where they amount to several hundred acres.

**Sect. IV. Grazing Husbandry.**

The principal dairy counties have been already enumerated. Of those appropriated to the making of cheese, Cheshire and Gloucestershire are the most famous. Much cheese is also made in that part of Shropshire which borders on Cheshire, and in North Wiltshire; the former goes under the name of Cheshire cheese; the latter was, till lately, called Gloucester cheese, now it receives its appellation from the county where it is made. A strong cheese, somewhat resembling Parmesan, is made at Cheddar, in Somersetshire. The rich cheese called Stilton, is made in Leicestershire, principally in the villages round Melton Mowbray. A rich cheese is also made at Leigh in Lancashire. The other cheeses made in England, which have acquired a peculiar name, either from the quantity made, or from the quality, are the Derbyshire, Stockton, Cottenham, and Southam cheeses. The last two are new-milk cheeses, of a singularly delicious flavour; the places where they are made are in Cambridgeshire. Bath and York are remarkable for their cream cheese. The county of Warwick, and Banbury in Oxfordshire also are remarkable for cheese: the former for the quantity made in it; about 19,000 tons being sent annually to London, besides a very large supply to Birmingham. The cheese made at Banbury is distinguished for its rich quality. The principal counties in which large quantities of butter are made, are Buckinghamshire, Cambridgeshire, Suffolk, Yorkshire, Dorsetshire, and Devonshire. Cambridge, Suffolk, and Yorkshire, annually supply London with about 60,000 firkins. Epping also is famous for its butter, nearly the whole of which is consumed in London; the quantity is about 20,000 firkins.

The richest grazing lands in England are, the Vale of Aylesbury in Buckinghamshire, the marsh lands of Somersetshire, the fens of Lincolnshire, Huntingdonshire, &c. Romney Marsh in Kent, and the midland counties, Leicestershire, Northamptonshire, &c. The natural fertility of some of these districts, and the fertility bestowed upon them, by the agricultural skill, capital, and industry of the farmer, is astonishing. On the rich grazing lands in Lincolnshire 2½ sheep have been kept on an acre during the summer, besides 1½ bullocks; and during winter, the same ground has kept two sheep per acre.

The hay made in this kingdom is either from the natural grasses, from clover and rye grass, or clover alone, or from sainfoin. The first description, or meadow hay, as it is called, is principally the produce of the western counties, where comparatively little clover is sown, and where meadows are most extensive and numerous. The mode of making this species of hay is carried to the greatest perfection in the county of Middlesex, particularly in the immediate vicinity of the metropolis. Clover hay, either pure, or mixed with rye grass, is most common in the southern, eastern, and northern counties. Sainfoin hay, is confined to those counties which have a calcareous soil, as on such a soil alone this plant can be profitably grown. The usual weight of a crop of meadow hay, is from one to one and a half tons per acre; of clover hay, from one to two tons; and of sainfoin hay, about the same quantity. In those counties, which are peculiarly favoured with an early and dry climate, clover is sometimes permitted, after it has been once cut, to stand for the purpose of procuring its seed; but by far the greatest proportion of clover seed is obtained from Holland and Flanders.

From the sketch which we have given of the arable husbandry of England, it will be perceived, that, with the exception of a few counties, it is by no means generally deserving of a high character for excellence and improvement. Many of the implements employed are constructed on bad principles, and awkwardly made; much labour and expense in the cultivation of the ground is thus needlessly thrown away. Besides, the ground in many counties is imperfectly ploughed and kept clean; and courses of crops are followed, which tend to exhaust it, or at least to prevent the farmer from reaping all the advantages from his expense and labour, which, under more judicious rotations, he could not fail to derive.

**Sect. V. Live Stock.**

But though the arable husbandry of England, on the whole, is thus defective and backward, the agricultural character of the country must be placed deservedly very high, on account of the breeds of its sheep and cattle, and the great improvements which within these few years have been made in them. Respecting the sheep of this country, we shall enter into pretty full and minute details; and we trust our readers will not deem these details too far drawn out, or superfluous, when they reflect, that the investigation and account which we shall afterwards give of our staple manufactory, will be thus rendered more full, satisfactory, and complete. As the same reason does not exist for being so particular respecting the other branches of live stock, we shall bestow on them a comparatively short notice.

Before, however, we proceed to describe and enumerate the different kinds of sheep that are kept in England, and to form an estimate of the quantity of wool which they afford, it may be proper to premise some general remarks respecting their management. Sheep are fed either on the mountainous districts of England and Wales, in the rich grazing grounds, especially in the midland counties, and on the marsh lands, or on arable farms. In the mountainous districts, the chief object is to breed them; where they are kept on grazing grounds, or on arable farms, the principal object is to prepare them for the butcher. In some parts of England they are kept on arable farms, not only for the purpose of being fattened, but also to manure the fallows, by being folded on them. This practice, however, is by no means general. On these farms, the most common mode of fattening them is by means of turnips, oil cake, hay, and corn.

There are great varieties of sheep kept in this country. Varieties

The principal kinds are, the Dishley or New Leicester, the Lincoln, the Teeswater, the Dartmoor, the Exmoor, the Dorset, the Hereford, the South Down, the Norfolk, the Heath, the Hardwick, the Cheviot, the Dunfaced, the Romney Marsh, the Wiltshire, the Bagshot Heath, and the Spanish or Merino. Of these, however, it may be remarked, that the Wiltshire and the Dorsetshire are nearly alike in their form, the quality of their wool, and their general properties; and that the Bagshot Heath sheep are nearly extinct, or, where remaining, are so
nearly allied to the Heath sheep; that they may be classed with them. The following Table will exhibit a clear view of these different breeds, according to their most important and distinguishing properties.

<table>
<thead>
<tr>
<th>Different Breeds, and distinguishing Properties.</th>
<th>Weight of fleece.</th>
<th>Weight per quarter.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dishley, ........................................</td>
<td>No horns, White face and legs, Combing wool, 7 lbs.</td>
<td>25 lbs.</td>
</tr>
<tr>
<td>2. Lincoln, .........................................</td>
<td>Ditto, Ditto, Ditto,</td>
<td>8</td>
</tr>
<tr>
<td>3. Teeswater, .......................................</td>
<td>Ditto, Ditto, Ditto,</td>
<td>8</td>
</tr>
<tr>
<td>4. Dartmoor, ........................................</td>
<td>Ditto, Ditto, Ditto,</td>
<td>8</td>
</tr>
<tr>
<td>5. Exmoor, ..........................................</td>
<td>Horned, Ditto, Ditto,</td>
<td>6</td>
</tr>
<tr>
<td>6. Dorset, ..........................................</td>
<td>Ditto, Grey faces and legs, Carding wool, 3½</td>
<td>18</td>
</tr>
<tr>
<td>7. Hereford, ........................................</td>
<td>No horns, Black faces and legs, Ditto,</td>
<td>2½</td>
</tr>
<tr>
<td>8. South Down, .....................................</td>
<td>Ditto, Speckled ditto, Ditto,</td>
<td>2½</td>
</tr>
<tr>
<td>9. Norfolk, .........................................</td>
<td>Horns, White faces and legs, Ditto,</td>
<td>2½</td>
</tr>
<tr>
<td>10. Heath, ..........................................</td>
<td>Ditto, Dun faces and legs, Ditto,</td>
<td>1½</td>
</tr>
<tr>
<td>11. Herdwick, .......................................</td>
<td>No horns, White faces and legs, Combing,</td>
<td>7</td>
</tr>
<tr>
<td>12. Cheviot, ........................................</td>
<td>Ditto, Ditto, Ditto,</td>
<td>3</td>
</tr>
<tr>
<td>13. Dun-faced, ......................................</td>
<td>Ditto, Ditto, Ditto,</td>
<td>1½</td>
</tr>
<tr>
<td>14. Romney Marsh, ...................................</td>
<td>Ditto, White faces and legs, Carding,</td>
<td>3½</td>
</tr>
<tr>
<td>15. Spanish, ........................................</td>
<td>Horns,</td>
<td>—</td>
</tr>
</tbody>
</table>

In our further remarks on the sheep of England, we shall divide them into two classes, the fleece is of which are distinguished from one another, both by the length of the staple and the mode of manufacturing them; the one being adapted to the fabrication of woollen goods, and the other to that of worsted. Long woollen sheep are found in many detached parts of England, but much more commonly on the eastern than on the western side, and often nearer to the coast than the middle of the kingdom. Amongst the larger ranges of long-wooled sheep, the most northern are found near the mouth of the Tees; the next range are found in that district, which comprehends the north-eastern part of Yorkshire, near the whole of Lincolnshire, and the Finlands of Huntingdon, Cambridge, and Norfolk. The same kind of sheep, with respect to their wool, are likewise found in the smaller marshes of Essex and of Kent, which surround the inlets of the sea; but, in the latter county, they are most numerous in the marshes of Romney and Guilford. Long-wooled sheep are also found in the counties of Dorset, Devon, and Cornwall, on the Cotswold hills, in some small and detached parts of Lincolnshire, Oxford, Bedford, and Stafford, through the whole of Leicestershire, Rutlandshire, Northamptonshire, and Huntingdonshire, and among the banks of most of the large rivers in the kingdom.

Having thus sketched out the districts in which the long-wooled sheep are found, we shall now proceed to consider these districts separately, and endeavour to estimate the number of sheep which each district keeps, and the quantity of long-wool which it supplies to our manufactories. To begin with the Teeswater:—in the county of Durham, where we first meet with them in proceeding from the north, the stock of these sheep upon the acres varies very much in different parts; probably, on the whole, there are about two sheep upon every three acres. The extent of land on which this breed of sheep are kept, cannot be more than one third of the county; according to this calculation, the stock of sheep will be 67,200; which, averaging the fleece of each sheep at 9 lbs., will give 2520 packs of wool.

In Yorkshire, the long-wooled breed of sheep are chiefly kept in the districts of Cleveland and Holderness. The former district maintains about 14,300, but their fleece cannot be rated higher than 8 lbs.; thus giving a quantity of wool amounting to 470 packs. The Teeswater breed are seldom seen to the south of Cleveland. The whole quantity of wool produced by them is nearly 3000 packs. The Lincoln breed was formerly very general over the district of Holderness, but latterly they have given way in a great measure to the Dishley; but, although this tract of land is very fertile, and well adapted to grazing, yet, as the breeding of cattle is the main object of the grazier’s attention, the stock of sheep is singularly light, there being probably not more than one to every four acres. According to this calculation, there will be 84,000 sheep, which, at 8 lbs., to the fleece, will give 2800 packs; the whole of which is sent to the manufacturers of the West Riding.

The natural advantages of Lincolnshire, the next district of long-wooled sheep, for the production of this kind of fleece, are great and numerous; and it is probable that they were first attended to here with spirit and profit, since it is known that the looms of Norfolk were supplied for nearly five centuries from the pastures of this county. The native breed of Lincolnshire, though much reduced in numbers, and lowered in fame, by the introduction of the new Leicester, still retain possession of a pretty considerable extent of the county. In other parts, a mixed breed between the new Leicester and the Lincolnshire are kept; by this mixture, the wool is rendered finer and shorter, and its colour is improved; but it has lost a large proportion of that toughness, which is an indispensable quality in good combing wool. The low lands of this county, as has been already remarked, carry a very heavy stock of sheep. Where no cattle are put on along with them, it is said, that eight sheep have been kept on a single acre. Probably, taking in the whole of the low grounds, and allowing for a stock of cattle, the average number of sheep is nearly three on an acre, which will make the number of sheep amount to 1,240,000; and averaging the weight of the fleece so low as 9 lbs., the produce of wool will be about 46,500 packs. As very few sheep can safely be kept during winter on the marsh lands, which extend from the mouth of the Humber along the coast, the stock on them can
not be estimated at more than half a sheep to an acre, which will give 85,700 sheep, and nearly 3000 packs of wool. In the greatest proportion of the other parts of Lincolnshire, short-woolled sheep are kept, which will be considered hereafter. There are, however, a few long-woolled sheep also, the stock being about two sheep upon three acres; the number of sheep is estimated at 505,700, and the quantity of wool 16,900 packs. To the pastures of the eastern and midland districts of this county, the looms of Norwich, Sudbury, Northampton, and Halifax, are indebted for the materials of workmanship.

The long-woolled breeds of sheep are principally met with in the western division of the county of Norfolk, called the Marshland. There are also some sheep of this description in the eastern point of the county, and on the banks of the Yare. The first tract may be regarded as the extreme part of the Lincoln district, on which there are about 11 sheep to eight acres, each yielding a fleece of 7 pounds. The number of long-stapled fleeces in Norfolk may be estimated at 38,500, and their weight at 1120 packs.

Although the Lincoln district of long-wool extends no further to the south-east, it yet stretches into, and comprises a considerable proportion of Cambridgeshire, particularly the fenland, and the isle of Ely. The stock here is very light, probably it does not exceed one sheep to two acres; the weight of the fleece is nearly eight pounds; the number of sheep being 41,700, the wool produced will be nearly 1400 packs.

It is extremely difficult to estimate the number of sheep, producing long-wool, that are kept in Huntingdonshire; the flocks of this county being of such various or dubious characters. Probably of the kind of sheep we are now considering, there are, in this county, 87,500, fed upon as many acres of land, which, taking the average fleece at 7 lbs, will give rather more than 2500 packs. Of these, part is combed and spun in the neighbourhood, particularly on the Northamptonshire border; another part is sent to Leicester, and wrought into stockings; a third portion is used in the manufacture of the Yorkshire woollens; and the remainder is manufactured at Bury St Edmunds, and at Norwich.

The next breed of long-woolled sheep that claim our notice, are the Dishley. In Leicestershire there were formerly two distinct breeds of sheep, known by the names of the old and the new Leiceste; but at present very few of the first are seen. The new Leiceste are principally met with in the county from which they take their name, in Rutlandshire, the inclosed parts of Northamptonshire and Warwickshire, and the richer soils in the eastern part of Staffordshire, and the south of Derbyshire; comprising an extensive tract, the second in point of dimension, which produces long wool. In consequence of the excellent system of sheep-farming practised in Leicestershire, and the natural fertility of the soil, it may be computed that this county maintains 380,500 sheep, which produce more than 11,000 packs of wool. Notwithstanding the very large proportion of common-field land in Northamptonshire, (which of course is incompatible, or at least highly unfavourable to sheep farming,) the stock is estimated at one to every acre, and the weight of the fleece at more than 6 lbs.; the whole produce being 16,000 packs of wool, from 640,000 sheep. In Rutlandshire, the number of sheep is supposed not to exceed 114,000, which, if the average weight of the fleece be 5 lbs., will give, as the produce of the county, nearly 2400 packs of wool. In the south-eastern quarter of Warwickshire, the stock of sheep is considerably heavier than in any other part of the county; and in the north-western quarter it is very light. Even on the richest soils, the number of sheep cannot be estimated at more than seven to eight acres of land; the weight of the fleece does not greatly exceed 5 lbs.; the number of sheep are about 160,000, consequently the annual produce is about 3400 packs. In Staffordshire comparatively few sheep are kept. Large flocks are found chiefly on the rich land near the banks of the Trent, in the south-east angle of the county; and even here the stock is probably not heavier than 7 sheep upon 25 acres; which, supposing that there are 14,000 acres, over which the heavy breed ranges, will give 3700 sheep, producing rather more than 100 packs.

The Romney Marsh sheep are the next species of long-woolled sheep which come under our consideration. They are almost exclusively confined to that part of Kent from which they take their name. In this very fertile marsh, it is estimated, that each acre keeps five sheep. The fleece, on an average does not weigh more than 7 lbs. though particular cases have occurred in which the weight has risen to 12 or 14 lbs. On the marsh there are probably 185,000 sheep, producing 5400 packs of wool. In the isle of Sheppey, some of these sheep are also kept; but though the weight of the fleece is the same, the stock per acre is less; so that on this part of Kent, the number of sheep and weight of fleece is less than might be expected from the natural fertility of the soil. Probably on the banks of the Thames and the Medway there are 108,000 sheep, furnishing nearly 3200 packs. Almost the whole of the wool of Kent is manufactured in the west of England.

In Devonshire there are two kinds of sheep; but the long-woolled are confined almost entirely to the southern division of the county. The fleeces are estimated at 9 lbs. on an average; but this estimate is too high, 8 lbs. being nearer the truth. The number of the long-woolled sheep in this county is about 194,000; which, at an average of 8 lbs. will give 1550 packs. The most singular, as well as the smallest of the districts which produce long-woolled sheep, are the Cotswold Hills in Gloucestershire; from which, it is said, though probably without foundation, that the Spanish flocks derive their origin. On the Cotswold Hills, the fleece, on an average, weighs about 8 lbs. The stock may be estimated at one to each acre, and the produce at about 6700 packs, there being about 200,000 sheep. Thus we have gone over all the districts that contain long-woolled sheep, and, from the statements we have given, it will be seen, that the total number of this kind of fleeces which England produces, is nearly 4,200,000, from about 4,000,000 acres of land; and the weight of the wool amounts to 131,000 packs, of 240 lbs. each. To this quantity must be added the weight of skin-wool procured from slaughtered sheep, which will probably bring the whole quantity of combing wool up to 187,228 packs.

The short-woolled sheep are not so easily arranged or short-wool-estimated as the long-woolled kinds. There are six different kinds of them; the Norfolk, South Down, Wiltshire, Reyeland or Herefordshire, the heath sheep, and the Cheviot or mountain sheep. The Norfolk sheep is found chiefly in that county, in Norfolk and Suffolk, and in parts of Cambridgeshire and Essex. In Norfolk, it is calculated that there are about 684,000
sheep, which at 52 sheep upon 59 acres of land, and at the average weight per fleece of 2 lbs. will give 5700 packs of wool. In Suffolk, where rich loams and clays abound more than in Norfolk, the sheep afford rather a heavier fleece, weighing probably nearly 2½ lbs. The stock is about 490,000, and the quantity of wool amounts to nearly 5000 packs. The Norfolk breed was formerly confined to the eastern part of Cambridgeshire, while the southern and central parts were occupied by the Wiltshire breed; but at present the Norfolk sheep are gaining ground in that county. The average fleece is rather less than 4 lbs. and the number of sheep is estimated at 47,000; these, with the sheep in the fens, which produce short wool, will make the entire quantity about 1120 packs.

A very small proportion of Huntingdonshire is devoted to the grazing of short-woalled sheep, and on the ground where they are kept, there is not a heavier stock than three-fourths of a sheep per acre; so that the whole number is not more than 108,000, producing about 2000 packs of wool. In Bedfordshire, the most careful and accurate observations make the stock of sheep to be at the rate of 52 sheep upon 97 acres; the average fleece is about 5 lbs.; the number of sheep 204,000; and the produce of wool about 4000 packs.

In Essex there was formerly a breed of sheep (probably native) which produced a fleece of long and coarse wool, usually weighing about 4 lbs. At present, the Norfolk, South Downs, Wiltshire, Dorsetshire, and Welsh sheep are kept in the centre of the county, while the Dishley breed are found along the coast. The Norfolk occupies the borders of Suffolke, and the Wiltshire the north-western part of the county. The Welsh, or at least sheep resembling the Welsh, are kept on Epping Forest. The number of sheep kept in Essex, (reckoning all the kinds which produce short wool,) may be at the rate of two upon three acres of land, and the average fleece at 3½ lbs.; the whole number of sheep at 519,000, and the quantity of wool at 6500 packs.

The next breed of short-woalled sheep which claim our notice, are the South Down sheep, which were first cultivated with success on that part of Sussex from which they derive their name. In this district it is usual to shear lambs; the quantity obtained from each being about 8 ounces; the sheep producing about 2 lbs. The whole stock, on their native soil, may be estimated at 316,500, and the wool which they produce at 2630 packs. If the rest of the county of Sussex is taken into the account, where the South Down sheep are kept, the whole number will probably reach 547,000, and the fleece 6800 packs. Most of the wool goes into Yorkshire, and a small part into the west of England. In the county of Kent, the flocks of short-woalled sheep amount to about 7000 packs, shorn from almost 324,500 sheep; each full grown sheep being estimated to produce 3½ lbs. of wool, and the lambs about 8 ounces. The manufacturers in the north of England take off most of the produce. The native breed of Hampshire are something between the sheep of Dorsetshire and those of Wiltshire, producing a fleece better than the former and worse than the latter; but the South Down have gained a considerable footing in this county. The stock is estimated at two sheep upon three acres; the weight of the fleece is about 3 lbs. and the total produce of wool is about 6500 packs, from nearly 517,000 sheep. In the isle of Wight are the Hampshire, Wiltshire, and Dorsetshire breeds, intermingled with the South Downs. The whole island is supposed to support about 61,000 sheep, producing nearly 300 packs of wool.

Suffolk is the last county in the southeastern district of short wool; it maintains the Dorset, Wiltshire, South Down, and a few Hampshire and heath sheep. On the strong lands, the stock is nearly five sheep on six acres, which gives 273,000 sheep. If to these be added the stock of the heaths, which may amount to about 16,000 sheep, and take the average fleece at 3 lbs. the produce of the county will be somewhat more than 3300 packs of wool, which is manufactured principally in Yorkshire and Lancashire.

In Wiltshire we enter on a new district of short wool. The management of the flock is well understood here, and the fold is the chief object for which it is kept; for this purpose the Wiltshire sheep are peculiarly well adapted. On the chalky division of this county their numbers are very great, the South Down sheep having, within these few years, gained admission along with the native breed. This district of Wiltshire is supposed to support 583,500 sheep, which yield, at 2½ lbs. each, a produce of nearly 6700 packs of wool. In the north-western part of the county a much lighter stock is kept, generally about three sheep to four acres, or perhaps, on an average, not more than one sheep to two acres. The number of sheep is estimated at 117,500; which yield, at three pounds of wool each fleece, 1490 packs. Nearly the whole of the wool is wrought in the western manufactures.

In Berkshire, the Bagshot-heath, Wiltshire, Dorset, in Berkshire and South Down breeds are kept. The average weight of wool produced by these different breeds, is about 3½ lbs. The stock about three sheep upon four acres; the total number 306,000; the whole produce 150 packs of wool,—part of which is wrought by the western manufactures, and the remainder used by those in the north of England.

In the southern division of Oxfordshire, the Wiltshire sheep are kept; about four on five acres; the fleece averaging 3½ lbs. while in the northern division it averages 4 lbs. In the whole county there are probably 804,000 sheep, and 5300 packs of wool. Of this quantity one part is used at home, in the manufacture of blankets at Witney, and of worsted slags at Banbury; a second portion is employed at Leicester, in the stocking trade; and a third is sent to the Yorkshire clothiers.

The wool of Buckinghamshire, with the exception of that which is produced on the chalk hills of that county, is fit for the use of the clothier. It is derived principally from sheep of the Dorset and Wiltshire breed, though in some parts the Dishley breed has been introduced. The stock in this county is about six sheep to eleven acres; the total number 283,000; the fleece, on an average, 3 lbs. and the whole wool produced 2800 packs: a small proportion of which is used in Leicester, by far the greater part going into the Yorkshire clothing country.

The sheep in Hertfordshire are chiefly of the Wiltshire breed, though the South Down are rapidly making progress in that county. The fleece of both kinds may be averaged at 3½ lbs.; the total number of sheep at upwards of 277,000; and the whole produce of wool at 5300 packs. Nearly the whole of it is wrought up in the north of England, some little at Leicester, and some in Suffolk, at Bury St Edmunds.
The vicinio of the metropolis, and the peculiar demands on agricultural produce which it creates, render Middlesex by no means remarkable, either for the number of sheep which it supports, or for the judicious nature of their management, or the quality of their wool. The stock here is extremely light, not being more than 19 sheep upon 22 acres; and as not half the ground supports this animal, the total number cannot be reckoned at more than 45,000; the average weight of whose fleeces being 4 lbs. the whole wool produced in this county is 750 packs.

In Dorset.

The sheep of Dorsetshire, it has been already remarked, resemble those of Wiltshire; in one respect, however, they are more valuable, at least to the sheep farmers in the vicinity of the metropolis, as they lamb very early in the season, and thus supply the London market, at a time when this kind of food is in great request, and consequently very dear. In the county from which they derive their name, they are, however, in some measure driven out by the introduction of the South Down. In the isles of Portland and Purbeck, and about Wareham and Poole, a small kind of sheep prevails, different from the native breed, and resembling the Welsh sheep. The stock of Dorsetshire is about 652,300, or 28 sheep to 51 acres. The average fleece is 3 lbs. and the whole produce of wool is 9900 packs. In this county the lambs are shorn, and the wool from them is about one-third of the quantity obtained from the dams. Most of the wool is employed in the manufactures of the west of England.

In Devon.

In Devonshire, besides the long-wooled sheep already noticed, there are several kinds which carry short wool; the average fleece of which may be estimated at 4 lbs. According to which, from 437,000 sheep, there will be produced about 7500 packs of wool, which is manufactured within the county.

In Cornwall.

Cornwall, both on account of the moisture of its climate and the nature of its soil, is ill adapted to sheep-husbandry. It is extremely difficult to form an estimate of the stock kept in this county; it is very light, probably not more than one sheep to four acres; the weight of the fleece is about 4 lbs.; the number of sheep about 200,000; the quantity of wool they afford, nearly 3400 packs. The yarn produced from it is partly wrought into the common serge of the county, and partly sent to Devonshire.

In Somerset.

In the east of Somersets the Wiltshire sheep are kept, and in the west the Dorsetshire breed. Besides these, there is a peculiar breed in Exmoor, and a sheep of very small size on the Mendip Hills. The weight of the fleece in this county varies very much; some not being more than 2 lbs. while others rise to 14 lbs. the average, perhaps, is about 4 lbs. The stock is light, not more than 10 sheep upon 17 acres; the number, 500,700 sheep; the produce about 9400 packs of wool; a small quantity of which is sent into Yorkshire, and the principal part manufactured within the county.

The sheep on the Cotswold Hills have already been noticed. On the hills in the eastern parts of Gloucestershire the Wiltshire breed are kept; in the vale of Gloucester, the same kind as on the Cotswold Hills; and to the west of the Severn the Herefordshire breed. The fleece of the first kind is about 5 lbs.; that procured from the vale 5 lbs.; and that from the Herefordshire about 2 lb. The whole stock is about 355,000; the produce in wool above 5400 packs; part of which is wrought in Yorkshire, and part in the home manufactury. The limits of the western district of short wool are accurately defined by the ocean, the Severn, and the chalky soil, which bounds that river towards the east.

In Herefordshire, another variety of the short-wooled In Herefordshire, another variety of the short-wooled sheep is found, which afford about 2 lbs. of very excellent wool; they are generally known by the name of Ryeland sheep. In this county, the practice of cutting their sheep is very common. The stock kept may be estimated at three sheep upon four acres; the number of sheep at 500,000; the produce about 4000 packs of wool, which is sent to the clothiers both of the north and the west of England.

Upon one-third of the land in Monmouthshire, a stock of one sheep to five acres is kept, each producing 1½ lbs. of wool; on the remainder of the soil there may be three sheep to four acres: the whole number being about 177,000 sheep, which yield 1400 packs.

The sheep of Worcestershire are in general small, in Worcestershire, particularly in the southern portion of the county, the farmers of which display great spirit in the improvement and extension of the best breeds; but the flocks of this county are in general light, by far the greater number weighing only from 1½ to 2½ lbs.; in the level country they sometimes weigh 4 lbs.; on the average, the whole may be calculated at 2½ lbs. The stock is nearly 17 sheep to 30 acres; the number of sheep 422,000, and the whole quantity of wool 4400 pack. The whole produce is manufactured in Yorkshire.

The greater part of Staffordshire supports short-wooled sheep. Here 21 occupy 150 acres of ground. The fleece weighs about 2 lbs. The total number of sheep is estimated at 183,000; and the packs of wool amount to 1520: the greater part of which is sent into Yorkshire, the remainder being wrought up in the county itself.

In the counties of Warwick, Lincoln, and Leicester, there are a few sheep bearing short wool kept. In the first mentioned county probably 183,000, producing 2500 packs of wool. In Lincolnshire, principally on the Wolds, and on the drier soils of the heaths of Ancestor and Lincoln, there may be kept of these kinds of sheep 123,000, producing 2800 packs of wool; the stock being two sheep upon five acres, and the fleece weighing nearly 3 lbs. Short-wooled sheep are found on the forest land of Leicestershire, where the number may perhaps consist of 20,000, and the whole fleeces 250 packs.

On the sandy soil of Nottinghamshire, to the west of the Trent, there is a small breed of sheep, producing nearly 2½ lbs. of fine wool. The enclosed land in the same part of the county contains a heavier stock, the fleece being 4 lbs. Over the whole of Nottinghamshire there may be about 27 sheep on 40 acres. The forest breed yields about 700 packs, the heavier breed nearly 2120, and the Dishley breed, which is also kept here, 1820; the whole number of sheep being about 255,200. Part of the wool of Nottinghamshire is wrought within the county, but by far the largest quantity is sent into Yorkshire.

In Derbyshire we meet with a new district of short...
wool, which extends from the high peak to the borders of Scotland, and from the moorlands of Yorkshire to the Irish sea. The sheep have black faces and legs; their fleeces are loose and coarse. Other kinds, however, are kept in this county. The average stock is about 21 sheep on 19 acres; the whole number kept 362,400; the fleece averages 3 lbs.; and the total quantity of wool may be estimated at 4530 packs, the market for which is in Yorkshire.

In Cheshire very few sheep are kept. They, in general, are small, producing short and fine wool. The stock is heaviest on the high grounds, on the eastern part of the county, and on the forest of Delamere. It is calculated that the whole number in the county does not exceed 15,000, which, yielding an average fleece of 4 lbs., give 380 packs of wool. In Cheshire, the skin-wool bears a much larger proportion to the fleeces than in most other parts of England.

Lancashire also supports few sheep. The return of stock in this county, made by order of government in the year 1803, includes 80,930 sheep; but this return is evidently grossly erroneous. It is much more probable, that, as there is nearly one sheep to three acres of ground, the whole number may amount to 310,000; and as the fleece averages 3 lbs., the quantity of wool produced in Lancashire may be estimated at 4520 packs, which is wrought either in the manufactures of the country, or in those of Yorkshire.

In considering Yorkshire as supporting short-wooled sheep, it may be proper to take the three Ridings separately. In the West Riding a great variety are met among others, the Dishley and the Cheviot. In the more fertile parts, the fleece probably weighs 4 lbs., and is at the rate of four sheep on seven acres; while on the hills, where the mountain breed are kept, the stock cannot be calculated higher than one sheep to eight acres, and the average fleece at 3 lbs. The produce of the whole of this Riding, therefore, is nearly 5000 packs of wool, obtained from 261,700 sheep. The long-wooled sheep of Holderness, in the East Riding, have been already noticed. On the Wolds, a great number of the short-wooled kind are kept; according to the best accounts, about 53 upon 40 acres; the fleeces weighing nearly 5 lbs.; the total number of sheep 366,240; the packs of wool 6400. In the North Riding, averaging the stock and fleeces of the eastern and western moorlands and the vale of York, the former may be one sheep to two acres, and the latter may weigh 6 lbs.; affording 4660 packs from 280,000 sheep. Most of the wool from the North Riding is sent into the west of England.

In Westmoreland, the breed of sheep is of the mountain kind. On the low lands of this county there is about half a sheep to an acre of ground, but on the mountains not half that proportion. It is calculated that the total stock may amount to 225,700 sheep, which afford 3260 packs, at 3 lbs. each; the greatest part of which is wrought by the manufacturers of Kendal, and the remainder sent into Yorkshire.

On the mountains of Cumberland, the Herdwick and the mountain breed are kept; and other varieties in the vale lands. Part of this county is very thinly stocked, on 200,000 acres there not being more than 50,000 sheep; on the remainder of the land there may be nearly half a sheep per acre. Over the whole county, perhaps, there are 378,400 sheep, producing 5000 packs of wool, at the average of 23 lbs. the fleece.

The Teeswater district of Durham, on the which the long-wooled sheep of that denomination are kept, has been already described. Over the rest of the county short-wooled sheep are generally kept; the average fleece may be estimated at 5 lbs.; the number of these sheep at 159,400; and the whole produce of wool at 3300 packs.

On the mountains of Northumberland the black-faced heath sheep are kept; but in other parts of this county a better stock prevails, namely, the Cheviot breed. On the mountains the stock is light, not amounting to more than 179 sheep on 277 acres; in the other districts it is heavier. Probably in the whole county there may be 558,000 sheep; and as the average fleece is about 4 lbs., the total quantity of wool will be 12,330 packs. The greatest proportion of this wool is sent to Yorkshire; a part of it to Aberdeen, and other places in Scotland; and the remainder is manufactured within the county.

Over nearly the whole of Wales the sheep are singularly small, with horns, white faces, and white legs; but the influence of different kinds of manufactures is visible on the flocks of the principality, especially on the flocks of Montgomery, over which the influence of the market at Welshpool for Welsh flannels extends. And in Glamorgan, a breed somewhat similar to those on the Cotswold Hills is kept. In North Wales the stock is light, five acres supporting not more than a single sheep, exclusively of cattle. In this division of Wales it may be estimated that 683,000 are maintained, producing nearly 5300 packs of wool, the fleece being reckoned, on an average, at 2 lbs. The principal marts for it are the fairs of Llanreost and Bangor.

On the mountains of South Wales, the same kind of sheep are met with, which occupy the mountains of the northern division of the principality; but they are more numerous in general; the fleeces are reckoned at 1 pound, and give as their total weight 5570 packs, the produce of 571,000 sheep: the home manufactures take off the whole of it.

Besides the various kinds of sheep which have been Merino described, the Merino or Spanish sheep must not be passed over unnoticed; they were introduced into this country about 14 years ago, and for some years were a very favourite breed; but it has been ascertained, that though the fleece does not much degenerate here, yet the carcase, which is naturally very ill formed, and affords comparatively little weight of meat, does not improve; and as the farmer, in the kind of sheep which he keeps, must look not only to the produce of wool, but also to the butcher market, he has found it his interest rather to return to the native breeds of his own country, and to give up the Spanish sheep; they are, however, been of considerable service to the flocks of England, having been judiciously and successfully crossed, in many instances, with the South Down, Ryeland, &c.

It may be proper, as well as useful and acceptable to General readers, before quitting this most interesting and important branch of our subject, to give the general results of the details into which we have entered.

In the first place, with regard to the long-wooled sheep of England, from the details which we have given, it appears that the number of sheep of this kind, kept in this country, amount to 4,153,308.

That the total number of acres on which they are maintained is 3,939,563.

That the average fleece of the long wool, varying in
ENGLAND.

From the data which have been given, the important and difficult point respecting the number of sheep in this country may be ascertained, with as near an approximation to the truth as can be expected on such a subject; the following table will exhibit the result:

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of long woolled sheep</td>
<td>4,158,508</td>
</tr>
<tr>
<td>Number of short woolled sheep</td>
<td>4,221,748</td>
</tr>
<tr>
<td>Total number of sheep</td>
<td>19,007,607</td>
</tr>
</tbody>
</table>

The grand result of these investigations, that the number of sheep in England and Wales does not much exceed 26 millions, and that the produce of wool is not annually 400,000 packs, we must acknowledge is at variance with the general opinion on this most important subject, which estimates the produce of England and Wales at 600,000 packs, and increases the number of sheep nearly in the same proportion; but this opinion either rests on no specific and particular data, or it is grounded on an erroneous estimate of the quantity of land in England and Wales, and, in the next place, on an overcharged calculation of the quantity of stock kept per acre. We have already had occasion to point out the error in the estimate of the quantity of land in this kingdom, which reckons it considerably above 40 millions of acres. The number of acres capable of supporting sheep certainly cannot be supposed much to exceed 32 millions of acres; the quantity of stock per acre has been averaged from the average stock of the different counties, by Mr Luceock, in his "Treatise on English Wool," whom we have followed through all these details, with great confidence, from a well-founded opinion of his minute and extensive knowledge on this important subject; and, with him, we have no doubt, that the estimate of 600,000 packs of wool, as the annual produce of England and Wales, is far above the truth, and that it does not reach 400,000 packs.

The original and established breeds of cattle, with their permanent varieties at present in England, are the following: First, the Devonshire; from these are derived the Herefordshire, the old red cattle of Gloucestershire, and the Sussex. The Devonshire are admirably calculated for draught, and faten easily; they are a most beautiful and well-formed animal: they are chiefly found in the county from which they take their name. The Herefordshire are rather larger than the Devonshire, but similar to them in most of their qualities; the cows yield a large portion of rich milk; they also are princi-
pally met with in the county from which they derive their name. At this time, it is difficult to find any specimens of the old variety of the Gloucestershire reds, which seem to have been a mixed breed from the Devonshire and Welsh cattle. The Sussex cattle are in high estimation for beef and labour; and with respect to milk, they excel the Devonshire and Herefordshire. They are a mixed breed, having been produced by a crossing of Welsh cattle. They are principally found in Sussex and Kent; in the former county, oxen are more used for draught than in most parts of England; great numbers of them are fattened in the marshes and meadows. In Kent are also found a different kind of cattle, called the Kentish home breed, which are well adapted for the dairy; they are of a mixed breed, the Sussex being most predominant, crossed with the Welsh, Alderney, &c.

The next breed consists of the Welsh mountain and lowland cattle; those of Glamorganshire are in high repute for draught; they resemble the cattle of Normandy. The Pembrokeishe somewhat resemble those of Glamorganshire, but they are not equally valuable. The next Welsh county in which the best breed of the principality occur, is Cardigan; but varieties of this breed are found all over Wales, and in most of the southern counties of England; they are in general quick feeders.

The next are the Lancashire, and north-western and midland country long horns: they were originally confined to Lancashire, Westmoreland, and Cumberland, from whence they spread to the south, into the counties of Derby, Nottingham, Leicester, Stafford, Warwick, Northampton, and Buckingham. It is rather a singular circumstance, that the neck of land, containing Lancashire and Cumberland on the western, and Yorkshire, Durham, and Northumberland, on the eastern coast, should have been the parent country, both of the long-horned and short-horned cattle; the latter extending from Northumberland southward, to the county of Lincoln. It was on the Lancashire long-horned, that Mr Bakewell made his experiments for the improvement of cattle, and the result was the new Leicester variety, which are calculated solely for the grazer, the old breed retaining their superiority in the dairy. The former are in great request in almost all parts of the kingdom.

The northern short horns, which include the Teeswater, Lincoln, Holderness, and Tweedside varieties, are the largest breed in England; the Hereford being next to them in that respect: their peculiar advantages are that they fatten kindly, and yield large quantities of milk and tallow; but their milk is not rich, and the cattle themselves are coarse and ill formed. They are principally found in the eastern counties.

The extreme coarseness and size of this breed led to the introduction of Norman and Alderney bulls, which were first imported into Holderness in Yorkshire; the mixture of these seeds has produced that useful and valuable variety, from which the stock generally kept by the London cow keepers is supplied. The pure Alderney breed, which are of a very small size, and are distinguished for being very rich milkers, are chiefly found in the south of England in the possession of gentlemen.

The northern, or Yorkshire polled cattle, are very similar in their qualities to the short horned, amongst which they are found.

The Norfolk home breed, formerly the principal stock in the county whence they derive their appellation, when attention was given to breeding in it, are now seldom met with, though they are still in much repute where they are kept, and bring high prices from the Smithfield salesmen.

The Suffolk dums, which are polled and small sized, are most excellent for the dairy, yielding abundance of rich milk: they are chiefly found in Suffolk and the adjoining counties, and are generally supposed to have originated in the polled Galloway breed of Scotland, with which Suffolk and Norfolk have been supplied during the last century.

There are no data, on which to found an estimate nearly approaching to the truth, respecting the number of cattle kept in England; though, as the English nation consume a much greater proportion of meat than most other countries, the number must be very considerable. Mr Arthur Young, in his Tour to the North of England, estimated the value of beasts at L. 36,480,000; and as at that period, the average value of cattle could not be more than 10, the whole number kept then was probably between three and four millions; the stock of cattle, since that time, has not increased much. By another mode of calculation, we may arrive at nearly the same conclusion: we have already seen that the annual slaughter of sheep is not quite one fourth of the total number kept in England and Wales; but the annual slaughter of sheep for the kingdom is about ten times as great as it is for London. Now the average annual supply of cattle for London is rather more than 100,000, which, for the whole kingdom, would be about 1,000,000; and if we reckon the annual slaughter of cattle for the whole kingdom as about one-fourth of the stock kept, we shall have about 4,000,000 cattle. It is evident, however, that in all this calculation, there is too much conjecture for the result of it to be regarded as a near approximation to the truth. It may be remarked, that Gregory King estimated the beoves, stirsks, and calves, in his time, at 4,500,000.

The rearing of calves forms an important branch of Rearing of husbandry, in some parts of this country, particularly calves in Essex, and in the vale of Aylesbury in Buckinghamshire. In Cheshire, more calves are fed during the months of March and April, than in any other part of England; but, as the milk cannot be long spared, they are killed very young. The suckling of calves, for the London market, is carried on to a considerable extent at Cottenham, in Cambridgeshire, (already mentioned as celebrated for its rich cheeses,) as well as in Essex.

There are several kinds of horses bred and kept in this country, well adapted for the saddle, either as road horses or as hunters; and for working, as well as for the race-course. In the midland counties, particularly in Northamptonshire and Leicestershire, a very large breed is kept. They are generally a dark black colour, and well adapted for the cart. It is said, that the improvement in this breed, which were originally ill-compacted in their make, took its rise from six Zealand mares, sent over by the late Lord Chesterfield, during his embassy at the Hague. The improved breed began in Derbyshire, at his lordship’s seat. It afterwards spread into Leicestershire, where Mr Bakewell, so deservedly celebrated for his improvements in the breed of sheep and black cattle, turned his attention, experience, and judgment to them, and still further improved them. The great demand for this breed is in London, where they are seen in full perfection in the dray-carts, &c. Yorkshire also has long been celebrated for its breed of horses, both for the saddle and for draught, but especially for the former. A variety of Bred of horses, which are of large and strong size, and are known in the market as “Yorkshire.”
of this animal, extremely well adapted for the plough, has lately been bred in the district of Cleveland. Suffolk also produces a breed of these animals, short, well compacted, and active, which are very valuable as farm horses. The Welsh horses are small, but active. In no country in the world has so much attention been paid to horses, for hunting and the race course, as in England; and this attention has been rewarded by the excellence of the animals reared. Foreign stallions of the most esteemed species, such as those from Barbary, Turkey, &c. have been procured at a very great expense; and, according to Buffon, the English horses, in respect to figure, nearly approach those of Arabia and Barbary. It has been said, that an Englishman is naturally fond of his horse; and this popular saying is confirmed by the very superior and attentive manner in which horses of nearly all descriptions are kept, of whatever class of people their owners may be. The fondness of the English for horse-racing has undoubtedly contributed to improve the breed, at least in respect to symmetry of form and speed. The best race-horses run 22½ fathoms in one second, or nearly a mile in a minute.

The number of horses employed in agriculture has never been very accurately ascertained. Mr. Marshall supposes that each square mile employs 20 horses, which is about 3 to 100 acres; if this supposition be correct, and we reckon that, in England and Wales, there are 80 millions of acres of cultivated ground, the number of horses would be about 900,000. The following facts will render this calculation still more probable: In 1804, the number of horses for which duty was paid in Great Britain, was 1,178,000; but, besides these, there were a great many others; and from the communications made to the Board of Agriculture on this subject, it was calculated, that at this period there were 200,000 pleasure horses, 40,000 cavalry horses, 1,200,000 employed in husbandry, and 850,000 colts and mares. Now, if we deduct from the 1,200,000 horses employed in husbandry in Great Britain, the number we may suppose to be employed in this way in Scotland, which is probably between a fifth and a sixth of what are employed in the whole island, we shall have between 900,000 and one million for the horses used in husbandry in England and Wales. In 1806, the number of horses was estimated at 919,924, of which about 20,000 were supposed to be employed in stage-coaches, post-chaises, and hackney-coaches. In the Appendix to the Report of the Committee on Broad Wheels and Turnpike Roads, it is calculated that 100,000 horses are in constant employment, in waggons, carts, &c. on the roads, for 300 days in the year. By the 13th George III. the load allowed to each horse is 16 cwt.; but let us suppose each horse carries half a ton, and goes 20 miles a day. The expense of carriage varies from 1s. to 2s. per ton per mile. On the 16 principal roads, the average is rather more than 1s. If we take it at 1s. and allow each horse to draw half a ton, two miles, the annual value of the labour will be L.150; and for 100,000 horses, L.15,000,000. The quantity of hay and oats necessary to keep pleasure horses cannot be reckoned at less than five acres; and the same quantity for cavalry horses. Perhaps four acres may be sufficient to keep horses employed in husbandry, on the roads, &c. while breeding mares and colts will not consume the produce of three acres. The expense of keeping each horse, on an average of all the kinds kept in this kingdom, even at the low price of 32s. per quarter for oats, cannot be estimated at less than L.52 per annum.

Mules and asses, especially the former, are not very abundant in England; and are scarcely, if at all, used in husbandry. They are in general larger than those of other countries, Spain, Portugal, and Malta excepted.

There is a great variety in the breeds of swine kept in this country, of which the following are either the most common, or the most valuable.

The Berkshire, which is small boned, and disposed to fatten quickly. It has extended from the district, from which it derives its name, over most parts of the island. It is the sort mostly fattened at the distilleries, and is good either for pork or bacon.

The Chinese breed, the size of which is small, and the flesh delicate, is also to be met with in almost every county. It is the best adapted for using as pork, but is seldom cured into bacon, being too small for that purpose.

The Gloucestershire breed, which Mr. Marshall supposes to have been formerly the prevailing breed of the island, is large, but ill formed. Its colour in general is white. It is a very unprofitable sort; and is chiefly confined to Gloucestershire, Shropshire, and the west of Devonshire.

The Hampshire breed is very large; but not so compact as the Berkshire. They are white, well disposed to fatten, and come up to a great weight when properly managed.

The Herefordshire is a large useful breed, but not by any means superior to either the Berkshire or Hampshire.

The Rudgwick breed, so called from a town of that name in Sussex, on the confines of Surrey, is supposed by Mr. Middleton to be the largest in the island; feeding to an extraordinary size, and, at two years old, weighing nearly double or treble the weight of other sorts of hogs of that age.

The Northampton breed, which are reared chiefly in that county, are of a large size, but they do not fatten very kindly. The breed of Shropshire is nearly similar to that of Northamptonshire.

The swing-tailed breed are not very numerous. Their size is small; their form well proportioned. They are very hardy, and fatten to a good weight.

A new variety of swine was introduced by the late Duke of Bedford, called the larger-spotted Woburn breed, which are very prolific, hardy, and well disposed to fatten, attaining nearly twice the size and weight of other hogs, within the same period of time.

The counties in England most remarkable for the quantity and quality of their hams, are Westmoreland and Yorkshire; and those in which bacon of the best quality is cured, are Wiltshire, Hampshire, and Berkshire. At Farringdon, in the last named county, upwards of L. 4000 worth is sold in the course of the year. Very little either of bacon or hams are exported; but they form a considerable branch of internal commerce.

Goats are reared in the mountainous parts of the north of England, particularly on the Cheviot Hills; but in much greater abundance in Wales. The breed of English and Welsh goats is large, and their skins valuable. Their milk also yields a profit.

Rabbit warrens are kept only on such kind of land as is not fitted for any more lucrative and valuable purpose. These are more numerous and extensive per-
It is calculated, that in the county of Worcester alone, there are in the inclosures, between 300,000 and 400,000 trees, principally oak, ash, elm, and willow, which might be removed, without any sensible injury either to the proprietor or the occupier of the soil.

Oak is by far the most important, though not the most abundant of English trees. It flourishes in great perfection on the Wealds of Kent, Surrey, and Sussex; in the hedge rows of Cheshire, in Monmouthshire, Flintshire, and several other parts of England and Wales; but there are some counties that produce very few oaks indeed, considering their size, perhaps not more than may be sufficient for their own consumption, such as Middlesex, the greater part of Hertfordshire, Oxfordshire, Wiltshire, Dorsetshire, Devonshire, Somersetshire, Gloucestershire, (with the exception of the forest of Dean,) Lincolnshire, Cambridgeshire, Norfolk, Suffolk, and several others.

But the principal supply of oak is derived from the Royal Forests, of which the following statement will exhibit the extent of the land, in which the timber belongs to the crown:

<table>
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<tr>
<th>Forest</th>
<th>A.</th>
<th>b.</th>
<th>c.</th>
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</thead>
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<td>26</td>
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<tr>
<td>Dean Forest</td>
<td>23,015</td>
<td>29</td>
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<tr>
<td>Aicholt and Woolmer</td>
<td>11,969</td>
<td>31</td>
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<td>Whittlewood</td>
<td>11,050</td>
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</tr>
<tr>
<td>Salcey</td>
<td>1,847</td>
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<tr>
<td>Whichwood</td>
<td>8,709</td>
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<td>Waltham</td>
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<td>Bere</td>
<td>928</td>
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<td>Rockingham</td>
<td>869</td>
<td>3 23</td>
<td></td>
</tr>
</tbody>
</table>

115,594 0 34

Besides the timber in these forests, the crown possesses much of it in Windsor Forest, and in the lands belonging to it, in the Duchies of Cornwall and Lancaster.

It is a generally received opinion, that the growth of oak timber is on the decline in this kingdom; and this opinion is confirmed by the result of two investigations, which were made at different and very distant periods, into the state of the oak timber in several of the Royal Forests. In the year 1608, a survey was made of all the timber that was fit for felling in the Royal Forest, and other estates of the crown. The whole, however, was not completed, neither the Forest of Dehsh, nor that of Whichwood, being comprised in the surveys; but the result appears to have been, that on the part of the Crown's estate that was surveyed, there must have been then growing about 649,880 loads of timber fit for the navy, and 1,148,650 loads of what was decayed and decayed. In 1783, another survey was taken, by order of the House of Commons, from which it appeared, that in New Forest, Aicholt and Woolmer, Bere, Whittlewood, Salcey, and Sherwood, there were only 50,445 loads of timber fit for the navy; whereas, in 1608, in these forests, there were 234,229; and that, in 1783, there were in these forests only 33,554 loads of decayed trees; whereas, in 1608, there were 265,145; so that the quantity of timber in 1783, in those forests, was little more than the sixth part of what it was at the former period. The general fact of the decrease of oak timber in nearly all the counties of England was further confirmed in 1791, by the answers which were returned by some of the principal timber merchants and land-surveyors, as well as by the chairman of the Quarter Sessions of the several counties in England and Wales, to questions sent to them by the commissioners of the land revenue.

Besides oak, elm, ash, beech, alder, and willow are elm, ash, common in the hedge rows, &c. of several of the counties. It is impossible to form an estimate of all these kinds of trees. Mr. Malcolm, in his survey of Surrey.
supposes, that of oak there may be five trees in every 20 acres; but this is evidently a random conjecture. An attempt was made some years ago, to have a survey taken of all the timber growing on private estates in England; but the surveys were interrupted by the proprietors before they got through the second county.

Sect. VII. Statistical Branch of the Agriculture of England.

We now come to the statistical branch of our present subject, which includes many curious, important, and highly interesting particulars; but, like all statistical enquiries, our investigations on this subject cannot be expected to proceed on data absolutely certain, or to give results quite conformable to the truth. The principal points to be ascertained, are the number of cultivated acres in England and Wales; the distribution and application of these acres; the value of their several kinds of produce; the rental of the land; the capital employed in agriculture; the profits arising from his labours and capital to the farmer; the number of people employed in agricultural pursuits, &c.

1. We have already endeavoured to show that the quantity of land in England and Wales is about 35,000,000 acres; it may be proper, however, to add, that by the accounts depended on by Mr Rose, the total acres are 37,334,400; and by the reports returned to the Board of Agriculture, the amount is 37,900,455, exclusive of Wales, which contains about 5,000,000 acres. The first point to be ascertained, whichever of these numbers we take, (and considering the impossibility of obtaining accuracy on this subject, as well as the total amount, the difference in these statements is not very considerable or important,) respects the quantity of waste land. In 1795, the Board of Agriculture referred the subject of the waste lands in the kingdom to a committee, who seem to have taken considerable pains in making enquiries and gaining information; from their report it appears, that at that time the number of acres of waste land in England was 6,259,470, and in Wales 1,659,093, making a total of 7,918,777. Dr Becke, who reckons the total number of acres to be less than the statements of the Board of Agriculture, or Mr Rose makes them, considers the number of acres of waste land to be also fewer; not estimating them higher than 6,477,000; to these, however, he adds, 1,310,000 for roads, water, &c. In consequence of the enclosure bills that have passed since the Report of the Board of Agriculture in 1795, the number of acres of waste land must be somewhat decreased: probably if from 38,500,000 acres, the total in England and Wales, 7,500,000 acres for waste land, roads, water, &c. are taken, we shall leave nearly the amount of the number of acres, either cultivated, or covered with useful timber, that is, 31,000,000 of acres.

2. The next point relates to the distribution and application of this quantity of land. There can be no doubt, both from particular enquiries in the agriculture of the several counties, and from the general and acknowledged fact of the great consumption of animal food in this kingdom, combined with another fact, as indisputed, that land under grass will not support nearly so many inhabitants as under the plough; that the proportion of pasture land is much greater than that of arable land. Dr Becke, in his pamphlet on the Income Tax, supposes that there are 17,881,000 acres in pasture, meadows, &c. while there are only 11,491,000 that are arable; according to other statements, the quantity of pasture ground is 17,479,000 acres. The Board of Agriculture calculates that there are 12,000,000 acres set apart as grass land for meat, and 4,000,000 acres for the dairy. The ground employed in the culture of hops, or for nurseries, is supposed rather to exceed 40,000 acres. The pleasure grounds, and fruit and kitchen gardens, may amount to 50,000 acres.

Taking the arable land at 11,500,000 acres, our next enquiry respects the distribution and application of it. It is probable, that notwithstanding the improvements in husbandry by the abolition of fallow on light soils, the old system of wheat, spring corn, or beans and fallow, is still followed on nearly six-tenths of the arable land of England and Wales, including the common field lands: three-tenths are probably under a rotation similar to that pursued in the county of Norfolk, of wheat, turnips, barley or oats, and clover; and the remaining tenth is under various rotations. According to this statement, 10,000,000 acres of arable land would be cropped in the following proportions: Wheat, 2,750,000 acres; oats and beans, 2,500,000; barley and rye, 750,000; roots, that is turnips, cabbages, &c. 1,000,000; clover, 1,000,000; and fallow, 2,000,000. If this statement, and the ratio on which it is founded, be correct, the number of acres under wheat may be estimated at about 3,200,000 acres; the oats and beans at about 2,800,000 acres; the barley and rye, at about 890,000 acres; the roots, at about 1,100,000 acres; the clover the same; and the acres of fallow at rather more than 2,200,000 acres. We must confess, however, not only that this estimate, like all estimates on this subject, is founded on insufficient data, but also that with respect to the number of acres which it assigns to barley and oats, it falls much below the estimate of Mr Arthur Young. According to him, there are 3,990,926 acres employed in the cultivation of wheat, and barley and oats occupy half as much land again as wheat, consequently the number of acres under these species of grain amount to 3,098,890.

The value of the produce of the cultivated land in England, it is evident, must vary very much, not only according to the different degrees of productiveness in various years, but also according to the price of corn, &c. On this subject, also, there are various conjectures and estimates. Before we proceed, it will be proper to endeavour to form some idea of the average quantity of the different kinds of grain, &c. raised on an acre of land, throughout the different counties of England and Wales. In this we shall be much assisted by the result of the enquiries of a committee of the House of Lords, on the scarcity in 1800. By their directions, the Board of Agriculture investigated the subject with considerable attention and minuteness; and in the Appendix to the Report, Tables were drawn up, from the answers sent to the Board, of the average produce of wheat, barley, &c. in nearly all the counties of Britain. These tables we have compared with the various agricultural reports published by the Board; and having supplied the deficiencies, and corrected them where they appeared to be erroneous, we shall lay, in one Table, the general results before our readers.
TABLE I.

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<th>Rye</th>
<th>Peas</th>
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</tbody>
</table>

Were the counties of England and Wales all of the same size, and did the proportions of wheat, barley, &c. cultivated in each county nearly correspond, we should be at little loss from this Table, to ascertain the average produce of the whole kingdom in wheat, barley, &c. Even as it is, we may from it infer, with tolerable accuracy, that the average produce of wheat cannot be rated higher than two quarters and a half per acre; of barley, four quarters; of oats, four quarters and a half; of rye, three quarters; of peas, two quarters and a half; of beans, three quarters and a half; and of potatoes 250 bushels. We shall not go into the details of all the calculations which may be formed from these average produce; but confine ourselves to the most important. The number of acres in wheat we estimate, at 3,200,000, which at 2½ quarters per acre, will give 8,000,000 quarters as the total product of England and Wales. That this is nearly the truth, will appear from this consideration: the quantity of wheat used annually by each individual may be estimated at six bushels; taking the population at the gross number of 10,500,000, this will give 63,000,000 bushels, or nearly 8,000,000 quarters. It may perhaps be objected, that the population of England and Wales is fed partly by imported wheat; but in answer to this we observe, that in estimating the produce we have not taken credit for seed-wheat, which, at one-ninth of the produce, is much more than we have imported on the average of some years. The value of this produce it is not so easy to ascertain, the price of wheat having varied so much of late years; but if we take it at L4 per quarter, the total value of the wheat crop, will be L32,000,000. Of the remaining 5,850,000 acres, (exclusive of fallow,) we may suppose that the average produce is about half the value per acre of the average produce of wheat; that is L5 per acre, which will give L29,150,000. The produce of the pasture land is probably worth L4 an acre on an average, which will give L60,916,000. The produce, therefore, of wheat, barley, oats, &c. and of pasture ground, will stand thus:

<table>
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<tr>
<th>Crop</th>
<th>Amount</th>
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<td>Wheat</td>
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<tr>
<td>Barley</td>
<td>29,150,000</td>
</tr>
<tr>
<td>Pasture</td>
<td>60,916,000</td>
</tr>
<tr>
<td>Total</td>
<td>L131,066,000</td>
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</table>

Exclusive of the value of the produce of hops, nursery, garden grounds, orchards, &c. Mr Arthur Young, in his Agricultural Report of Essex, estimates the rental of England at L30,000,000, and the value of the produce, (taking all kinds of it into the account,) at L145,800,000. Mr Middleton, in his Survey of Middlesex, enters into very minute and laborious calculations on this important and difficult subject; and the result of his enquiries is, that the whole agricultural produce of the agricultural capital of England and Wales is L126,690,000; and this result he arrives at, notwithstanding he rates the total number of acres in the kingdom much higher than we do, by estimating the average crop of all kinds of produce of arable land at only L5 per acre, which is certainly at present much below the truth. 4: On this subject, however, we shall probably be enabled to come nearer the truth, if we can determine the rental of the lands in England and Wales; since it is well known, that the produce bears a certain proportion to the rental. Formerly, land-surveyors in valuing land, or giving their opinion respecting the rent which it ought to afford, considered that the average produce should be equal to three rents; but at present, in the opinion and practice of the most intelligent and experienced, it is calculated that the rent ought to be only one-fifth of the produce. The actual rent of England and Wales is impossible to ascertain exactly; but the rack-rent, or the rent at which the lands are valued in the opinion of judicious and experienced men, was returned to the House of Commons in the year 1810, by the commissioners of taxes: This return we lay before our readers in the following Table.
### TABLE II.

<table>
<thead>
<tr>
<th>Counties</th>
<th>Annual Value of Land at Rack-Rent</th>
<th>Annual Amount of Profits arising from Farming</th>
<th>Number of Families employed in Agriculture</th>
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</thead>
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<td></td>
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<td>Middlesex</td>
<td>344,230 11 1</td>
<td>346,087 12 4</td>
<td>9,638</td>
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\[ L.29,509,073 \times 4.5 = L.132,763,928 \]

In calculating the value of agricultural produce by means of it, it seems fair, as it exhibits the rack-rent (though where the lands are let at their full value, the rack-rent and real rent must correspond, and in some cases, the real rent would be above the fair rent, or that rent which would be quintupled in the produce,) to consider it as \( \frac{4}{5} \), instead of \( 5 \) times the value of the rent. If we go on this supposition, then the value of the agricultural produce will be exhibited thus, \( L.29,509,073 \times \frac{4}{5} = L.132,763,928 \), which differs very inconsiderably from the result on this point, which we obtained by the former mode of calculation. It may,
perhaps, be thought, that as we before averaged the rent of land at 20s. per acre, we over-rated it; since, at this estimate, the total rent would be greater than this Table proves it to be; but in our estimate, we took into account only such pasture land as is let by the acre; and of course excluded all the downs, sheep-walks, &c.

5. About twenty-four years ago, Mr Young estimated the capital employed in agriculture in L.4 the acre; since that time it has increased very much; probably it is more than doubled; so that if we take every thing into account, it will now require L.10 per acre, or at least L.8. The number of cultivated acres has been estimated at 31,000,000, which, at L.8, would require a capital of L.248,000,000; and, at the latter rate, of L.310,000,000: Let us take the medium, and the agricultural capital will amount to L.279,000,000. On this point Dr Hooke's statement is very much at variance with ours; for he estimated the farming capital in 1800 at L.125,000,000, taking it on an average at 5 clear rents, viz., pasture 2 to 3, and arable 5 to 7 rents; but, as he estimates the average rent of England and Wales only at 1½s. the acre, this would be making the capital only L.4 the acre; a sum, even at that period, much too small. Besides, he estimates the net profits of the farmers at L.15,000,000, which we shall immediately prove is little more than the amount of half their profits; and consequently, as the profits must always bear a certain proportion to the capital employed, if the statement respecting the profits is only about half of the truth, the statement respecting the capital must be erroneous in much the same ratio.

6. The same Table (No. 2, p. 736.) which exhibits the amount of the annual value of the land in England and Wales at rack-rent, gives also an account of the annual amount of profits arising from farming land, drawn up from the returns made to the tax-office respecting the income-tax, and presented to the House of Commons. From this column of the Table it appears, that the farming profits are L.294,476,852, or nearly the amount of the rent. Now, in order to arrive at the amount of the capital employed in agriculture, from the amount of agricultural profits, it will be necessary, in the first place, to fix the rate per cent. of the profit. This certainly cannot be reckoned at a lower rate than 10 per cent., which would make the agricultural capital amount to L.294,768,520, which, considering the magnitude of the sum, and the imperfection of the data on which we are obliged to proceed, does not differ very considerably from L.279,000,000, the amount of agricultural capital at which we arrived by calculating it at L.9 per acre.

7. The next enquiry into which we shall briefly enter, respects the absolute value of the landed property in England and Wales. Having ascertained the amount of the rack-rent, we shall have little difficulty in elucidating this point, provided we can determine the number of years' purchase at which land is sold; that is, how many rents ought to be given for the fee-simple of land. Mr Arthur Young, in his Enquiry into the progressive Value of Money, estimates the rate at which land was sold in the year 1811, at 28 years' purchase. As this, however, must have been on the real, and not on the rack-rent, some deduction must be made on that score; while, on the other hand, no addition ought to be made to the rate since 1811, as the value of land certainly has not increased since that year. Assuming, therefore, that L.28,000,000 was the amount in that year, either of the actual rent, or of the rent of such estates as were within a very short period of the expiration of their leases, we shall have the total amount of the value of the landed property of the kingdom, if we multiply this sum by 28; this will give L.784,000,000 as the result.

8. By the returns under the population act in 1811, it appears that the number of families employed in agricultural operations in England was 697,358; and in Wales 72,846, making a total of 770,199. The average number of people in a family is about 4·5; which will make the whole number of people employed in agricultural operations 3,465,895. The number of farmers, or persons occupying farms, is supposed to be about 200,000. On this supposition, if we take the amount of their profits at the round sum of L.30,000,000, the average profit of the farmers will be about L.150 per annum.

It is scarcely necessary to repeat the observations which we have already made more than once, that the result of all these calculations must be considered as merely approximations to the truth. We are also sensible, that, with respect to some of the statements of which we have made, they differ from those given by statistical writers. This difference is accounted for, we trust, favourably to the superior accuracy of our statements, by our grounding them on the results of Table No. 2, p. 736; which must be regarded as resting on more minute, careful, and extensive enquiries, than any private individuals could make. In defence of the accuracy of our statements, we would likewise observe, that they are at variance with statements made 10 or 15 years ago; and we need not remind our readers, that, even within that short period, the advance on the value of every thing (from whatever cause proceeding) has been great. There is only one point on which we feel hesitation and doubt; and that is, respecting the capital per acre required in agriculture. Yet if Mr A. Young came near the truth in estimating the English capital employed in agriculture in 1789 at L.4 an acre, whoever reflects on the increased price of all the expenses attendant on a family and a farm, as well as on the different manner in which farmers now live, will not deem L.9 per acre as an overcharged estimate of the capital which a farmer, who expects to do justice to himself and his farm, ought to possess for every acre on which he enters.

Before we conclude this branch of our subject, for the length of which we must apologise on the ground of its extreme importance, we shall offer a few historical notices on English farming at various periods. This will enable our readers to judge of its progress, and to compare its former with its present state; for statistical enquiries, which are confined entirely and exclusively to the present state of a country, are neither so interesting, instructive, nor so intelligible and connected, as those that also embrace some notice of its former state.

The first decided and important epoch in the history of English agriculture may be fixed in the reign of Henry VII, when a notion began to prevail among the nobility and gentry, that their estates might be rendered much more valuable to them, by being employed in grazing than in tillage. In consequence of this opinion, which was acted upon for this and the two succeeding reigns, there was much discontent among the lower classes of the people; till at length in Elizabeth's time, acts were passed for promoting and encouraging tillage, which were supported by Lord Bacon, and opposed by Sir Walter Raleigh, who thought it impossible to
England.

render grain a staple commodity of this country. His speech exhibits a striking picture of the state of English agriculture at that period. According to him, the poor farmers could not purchase seed to sow the land, which the law required to be sown; and France offered the Queen to supply Ireland with corn at two shillings a bushel, at which price our farmers would be beggars. It would seem that the tillage laws passed by Elizabeth were found to be inefficient, if not injurious, for by an act of the 39 Eliz. they were repealed.

There does not seem to have been any regular mode of conducting the husbandry of this kingdom, or any essential improvements introduced into it, till the restoration of Charles II. At this period, many of the landlords, who had assumed the cause of that monarch, and retired to the continent, on their return introduced several of the principles and modes of practice which they had observed abroad, particularly in Flanders. There is, indeed, good reason to believe, that clover, saffoin, the folding of sheep, and perhaps turnips, (though the introduction of the last is generally fixed at a much later period,) were brought into this country about the time of the restoration of Charles II.

After this time, agriculture advanced slowly but gradually, being in some instances benefited, and in other instances rather obstructed, by the works of some fanciful writers. We allude particularly to the writings of Tull, which have been of essential service in contributing to introduce the row culture at least for green crops, but which had a tendency to do mischief, by insisting on the uselessness of manures.

Hitherto, whatever improvements had taken place in arable husbandry, little attention had been directed to the improvement of the stock of the island. At last Mr. Bakewell turned his thoughts to this subject, and his example being followed by several spirited and judicious farmers in various parts of England, more particularly in the north, this branch of husbandry, as we have already remarked, has, in by far the greatest portion of the kingdom, advanced considerably before its arable husbandry; and indeed the principal and most important improvement in this latter branch may very fairly be traced to the great improvement in stock; for the zeal and anxiety of farmers with respect to their stock, led them to cultivate green crops on a larger scale, and with more attention and judgment, than they had previously done; and by means of these crops, not only was their ground kept clean, but it was also enriched, by the additional quantity of manure, which the consumption of them supplied.

The last epoch in the history of English husbandry was the establishment of the Board of Agriculture; from which perhaps not all the benefit has been derived which was expected, and which might have been obtained, had their proceedings been more cautious and judicious; but which nevertheless has contributed greatly to spread agricultural information, to make each part of the country acquainted with the implements and practices of the other parts, and to soften and break down agricultural prejudice, of all prejudices the most stubborn and long-lived.

Still, whoever has formed his opinion of the excellence of English agriculture, from the high character which this nation bears for enterprise and success in other branches of industry, and particularly in manufacturing and commercial industry, will be much disappointed. Over the whole kingdom, and even in the immediate vicinity of the largest towns, where the demand for agricultural produce must be great and regular, and where the means of improvement are ample and easily acquired, wastes and commons are found, many of them consisting of a soil by no means naturally unfertile, and all of them capable, at little expense, of being rendered in some degree productive and beneficial to the inhabitants. Besides these wastes and commons, what are called common fields (where the ground, though cultivated, is so much subdivided, and the property so much intermixed, that it is absolutely impossible to practise good husbandry, or to derive from it the produce it might yield) are numerous. While these things are so, the agricultural industry and enterprise cannot be rated very high. At the same time it is fair to state, that within these last 50 years, numerous acts of parliament have been passed to inclose and improve these commons and common fields; while before his present Majesty came to the throne, these acts were very few. The first inclosure by act of parliament took place in the reign of Charles II.; the next in Queen Anne's reign. From 1719 to 1759, 249 acts were passed; from 1764 to 1779, the number was 941, averaging 58 annually; from 1780 to 1794, there were 445, averaging 30 annually; in 1795 and 1796, there were 146; and from 1797 to 1805, there were 704; making in all 2,991 inclosure acts. In the ten years from 1785 to 1796, the average number per annum sunk considerably; but in the nine years, from 1796 to 1805, it rose again higher than ever. In the first 40 years of his present Majesty's reign, there were 1213 inclosures, containing 1,990,189 acres, which gives an average for each inclosure of 1616 acres. If we estimate the total number of inclosures at this average, the quantity of land inclosed since the reign of Queen Anne, (for the inclosure in Charles II.'s time related to Malvern Chase,) will amount to 4,187,056 acres, up to the end of 1805. Since that period, the acts for inclosing commons and common fields have not been less numerous. We have entered on this statement, in order to shew, that, though these commons and common fields are a disgrace to the agricultural character and enterprise of the English nation, yet that disgrace is in the course of being wiped away.

It has been more than once noticed, that our agriculture has improved more with respect to farming stock, than with respect to the principles or practices pursued on arable land. Perhaps the truth of this observation cannot be placed in a stronger point of view, than by the following comparison between the weight of bullocks, &c. as it was one hundred years ago, and as it is at the present time.

<table>
<thead>
<tr>
<th>100 Years ago</th>
<th>At present</th>
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<tr>
<td>Bullocks at an average weighed</td>
<td>370 lbs.</td>
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<tr>
<td>Calves do.</td>
<td>50</td>
</tr>
<tr>
<td>Sheep do.</td>
<td>28</td>
</tr>
<tr>
<td>Lambs do.</td>
<td>18</td>
</tr>
</tbody>
</table>

Horticulture.

The horticulture of England is so justly celebrated, and is so closely connected with its agriculture, that we may be permitted to say a few words on the subject. When we consider the general coldness and moisture, as well as the extreme uncertainty and variability of our climate, it must be regarded as no unequivocal proof of our skill and success in horticulture, that by any means we are enabled to supply ourselves with as many

3
kinds as we do possess, of the fruits of more favoured and warmer countries. Nor are our kitchen gardens less distinguished for the variety and excellence of the vegetables which they produce. From the very great and constant demand that the fruit and vegetables which the most tropical regions of the world produce, the gardens in its vicinity are superior to any others, in the attention and skill with which they are cultivated, and in the returns that they make for the money and labour expended on them. The fruit gardeners near London not only stock their ground with apples, pears, cherries, plums, &c. which they call the upper crop; but they have also an under crop, consisting of raspberries, strawberries, &c. On these garden grounds it is supposed that a population is supported at the rate of ten persons per acre. We have particularly specified the gardens in the neighbourhood of London, as exhibiting proofs of English skill, enterprise, and success in horticulture, beyond what the gardens in the country exhibit. But in the vicinity of most of the large towns in England, and even at the distance of 15 or 20 miles from some of them, the excellence of our horticulture is apparent.

In ornamental gardening, and the laying out of grounds, England is also celebrated, being deservedly regarded as the parent country of real taste in this respect. Nowhere is so much attention, and, if the expression may be allowed, deference paid to nature, in the laying out of grounds, as in England. Such is the picture of this country, with respect to the result of the application of the capital, industry, and skill of its inhabitants, to the cultivation of the soil.

CHAP. VIII.

Of the Produce of Mines and Quarries.

The next branch of industry which we are to consider and investigate, is that which is employed in the mines and quarries of the kingdom. In the remarks which we offered on the mineral geography and geology of England, the produce of the mines was noticed in so far as it was connected with that branch of our subject: but it is now to be considered in another point of view. In what we are about to offer, we shall, as far as our materials enable us to do it, in the first place, enumerate the principal mineral productions of this country, on which the industry and capital of its inhabitants are employed, (so far as regards their unmanufactured state); in the second place, we shall point out the parts of the kingdom in which they are found; and, lastly, we shall endeavour to form an estimate of the quantity produced, the value of the produce, and the number of people employed, as well as particularize the uses to which the various substances are respectively applied. We must premise, however, that on the last head, our information must necessarily be either very loose and conjectural, or limited and partial, since there are not data on which to ground results, not only accurate but complete. In this alternative, we shall prefer giving what we know to be correct, though thus we must unavoidably pass over some part of our subject, to offering vague and unfounded conjectures and speculations.

I. It has been truly and justly observed, that "it seldom or never happens that countries abundant in the productions of agriculture should, at the same time, present an opulent mineralogy: yet England is far from being deficient in this respect." The author of this remark might have been justified in going farther, and in asserting, that England, with respect to those treasures which she draws from the bowels of the earth, holds a distinguished place among European nations, not so much perhaps on account of their very great abundance and natural richness, as on account of the industry, skill, and enterprise, with which she has availed herself of these treasures, and of the capital at first produced by these qualities, and afterwards brought to bear in conjunction with them, so as to raise her, in point of national prosperity, power, and wealth, to the exalted situation in which she now stands. In another point of view, also, may her mineral productions be, honourably for herself, distinguished from those of most other nations: with them, industry, or capital, or both, are in general merely sufficient to procure the minerals in their natural state, or at most, to change them into their rudest and least valuable form; but in England, the various minerals which are found in the bowels of the earth are, for the most part, by the skill and industry of her inhabitants, either converted into the most precious and exquisite, or the most useful and important articles, that the taste, the luxury, the comforts, or the wants of man demand; or they are made the instruments and means of producing those articles in the greatest abundance, and with the smallest application of capital and labour. The truth of these observations will be abundantly apparent, when we enumerate the principal mineral productions in this country, scarcely one of which will not call up to the mind of the most ignorant and careless observer, the rude material of what he daily uses, or the means of producing that rude material.

In point of importance, not only on account of its great abundance and utility here, but also on account of its comparative rarity in most other countries, coal must be mentioned: then perhaps tin, as another mineral, by which England is distinguished from most other nations: black lead, also, (though found here only in a very few places, and only in one place in abundance), claims our notice as an almost exclusive mineral possessed by England. After these, may be mentioned iron, lead, and copper; of what are called the inferior metals, (which are rare everywhere), zinc and manganese may be mentioned as the most important in our manufactures. Of the productions of our quarries, as distinguished from the productions of our mines, marbles and freestone, or calcareous sandstone, of various colours and textures, are in many parts of the kingdom abundant. There are also mines of rock salt, pits of fuller's earth, potter's clay, &c.

II. With respect to the counties in which the mineral productions just enumerated are found, to begin with coal, it may in general be remarked, (as has indeed already appeared from our account of the mineral geography of England), that it abounds in all parts of the kingdom, except the eastern, southern, south-eastern, south-western, and a few of the midland counties. In the following counties, it is found in greater or less abundance: Northumberland, Durham, Yorkshire, Cumberland, and Lancashire, in the north of England; in this northern district, Westmoreland is the only county destitute of coal; in all the rest it is very abundant. To the south of these counties, coal is found in Derbyshire, Staffordshire, and Shropshire: it is wanting in Cheshire on the west side, and Nottinghamshire and Lincolnshire on the east side of this district. Of the midland counties, Leicestershire and Warwickshire are the only two which possess this valuable mineral, none being found in Northamptonshire, Rutlandshire, Oxfordshire, or indeed to the south of
ENGLAND.

Statistics.

east of these counties; so that, besides the counties enumerated in these directions, Huntingdonshire, Cambridgeshire, Norfolk, Suffolk, Essex, Middlesex, Kent, Surrey, Sussex, Hertfordshire, Hampshire, Buckinghamshire, Bedfordshire, and Berkshire, are destitute of coal. As we incline to the west, it is also wanting in Wiltshire, Dorsetshire, Worestershire, Herefordshire, Devonshire, (with the exception of the bovey coal), and Cornwall; Gloucestershire, Somersetshire, and Monmouthshire, being the only counties that possess coal mines in this portion of England. With respect to North Wales, coal is found in Flintshire and Denbeighshire; and in South Wales, in Pembroke, Caermarthen, and Glamorganshire. Iron is found in Cornwall, Cumberland, Derbysire, Devonshire, Durham, Gloucestershire, Hampshire, Kent, Lancashire, Monmouthshire, Northumberland, Shropshire, Somersetshire, Staffordshire, Sussex, Warwickshire, and Wiltshire; but it is most abundant in Shropshire, Gloucestershire, Derbysire, the north of Lancashire, and Wales. Lead is found principally in Derbyshire, Cumberland, Northumberland, Somersetshire, Devonshire, Yorkshire, Durham, Westmoreland, Carlignan, Flint, and Montgomery. Tin is found in Devonshire, and the adjoining parts of Devonshire; and black lead to a small district in Cumberland. Mines of copper are wrought in Cornwall, Devonshire, Derbyshire, and Anglesey, and partially in Yorkshire, Staffordshire, &c. zinc is met with in Derbyshire, Cornwall, &c.: manganese on the Mendip hills in Somersetshire: rock salt in Cheshire and Worcestershire: alum slate in Yorkshire: gypsum or alabaster in Derbyshire and Nottinghamshire: fuller's earth in Berkshire, Bedfordshire, and Surrey: potter's clay principally in Dorsetshire: — and the stone quarries the most celebrated for the abundance and excellence of their stone, are those of Portland, Purbeck, Bath, Yorkshire, Northamptonshire, &c. The most extensive quarries of slate, (as has been already mentioned), are in Westmoreland, Yorkshire, Leicestershire, North Wales, Cornwall, and Devonshire.

Copper.

III. It is extremely difficult to form an estimate of the quantity produced, of the most important of these minerals, of the value of the produce, or of the number of people employed. The consumption of coal in the kingdom must be enormous: in private families, its course depends on the nature of the climate, the condition of the family, and the price of the coals. The following facts may perhaps supply data, by means of which we may arrive near the truth, respecting the consumption of coal for domestic uses. In London, the consumption is nearly about a ton annually for each individual, or perhaps more correctly about three chaldrons (Winton measure, or 28 cwt.) for each house. This appears from the amount of the quantity brought into London from Newcastle, and by means of the Paddington canal. In Manchester, where the climate is colder, and the coals cheaper, it is calculated that each individual uses two tons annually; or, supposing each family to consist of 4.5 individuals, this will give 10 tons for each house, or about seven chaldrons, Winton measure. In Newcastle, where the weather is still colder, and the coals cheaper, the mean consumption is one third of a Newcastle chaldron (nearly 18 cwt.) per month for every constant fire, equalizing the kitchen fire with the rest, which is as much for every fire as is consumed by each family in Manchester; and reckoning one and a half fire through the year, will give 10.5 chaldrons as the annual consumption. This perhaps may be taken as the extreme consumption of coals in families in the kingdom; and supposing the consumption in London to be at the lowest rate, the medium will be 6.75 chaldrons for each house in the kingdom in the course of the year; let us suppose it to be six chaldrons, the number of houses in England is 1,797,504: the total consumption of coals, therefore, for domestic use, will be 1,797,504 x 6, or 10,782,924 chaldrons, or rather more than one chaldron for each individual. This, it must be confessed, is mere conjecture; but it is probably not far from the truth. We shall not even offer a conjecture of the quantity of coals used in our manufactories, but content ourselves with stating the following facts. If the medium of the steam engines consist of 30 inch cylinders, they will consume 18 bushels of coals per day, which is equal to three chaldrons per week, or 156 chaldrons per annum. The salt-works in Cheshire consume 150,000 tons of coals annually. The smelting of the copper ore of Cornwall consumes nearly 200,000 tons of coals per annum; and it is calculated, that in the brass and copper manufactories, there are used nearly as many. In the Coalbrook-dale district of Shropshire, about 250,000 tons are raised annually — a great proportion is used in the iron works. The extensive iron works of Messrs Ferraday in Staffordshire, are said to consume 1000 tons per week. In two blast furnaces in Sheffield, from 600 to 800 tons of coals are used per week: and in the large iron works 1200. Indeed, when we consider that there are nearly 200 furnaces in which coke alone is used, the consumption of coal in the iron works of England must be regarded as immense.

In addition to these proofs of the very great supply and consumption of coal, the following miscellaneous facts may be stated: The quantity of coals raised yearly in Northumberland and Durham, is estimated by Mr Bailey at 1,000,000 chaldrons, Newcastle measure, (which contains 68 Winchester bushels, and weighs 53 cwt.) and he supposes that in those counties there are 200 square miles, or 128,000 acres of coal proper for exportation. In the year 1800, a committee was appointed by Parliament to inquire into the state of the inland coal trade; and from the evidence adduced, it was proved that in the neighbourhood of Dudley, very thick and rich seams of coal were wrought; that at Swansea, upwards of 500 vessels were annually employed in the trade, besides that the copper works there consumed from 1500 to 2000 tons per week; that in Leicestershire, there are many beds of coal very imperfectly and partially wrought; that a supply of coal to the amount of between 50,000 and 100,000 tons might be brought from Newport in Wales to London annually; and that not less than from 150,000 to 200,000 acres of coal are found in the neighbourhood of Leeds, Wakefield, &c. Besides our internal consumption, it is calculated, that in time of peace, nearly 150,000 Newcastle chaldron of coals are exported, principally to Holland, Hamburgh, the Baltic, Spain, and Portugal; and that between 300,000 and 400,000 chaldrons (Winton measure) are sent from Whitchaven, Workington, &c. in Cumberland.

The number of people employed, either directly or indirectly, in the coal trade, must also be very great: In 1792, it was calculated, that on the rivers Tyne and Wear, there were 64,724 men and boys employed; it has also been estimated, on tolerably good data, that in Durham and Northumberland, the proportion of men is as 10,650 to 1,480,080 chaldron of coals:— in both these estimates, however, it is proper to remark, that the seamen who navigate the colliers are taken into the account.
It appears that the iron mines of this country were wrought at a very early period, since iron works are known to have existed in the Forest of Dean in Gloucestershire, before the year 1066. In 1581, in consequence of the great consumption of wood which they occasioned, they were restrained by act of Parliament. In 1624, a patent for smelting iron with pit-coal was exempted from the law against monopolies; but the use of wood for this purpose seems still to have continued; for in 1719, complaints were made that the waste and destruction of the woods in the counties of Warwick, Stafford, Worcester, Hereford, Monmouth, Gloucester, and Salop, by the iron works, was not to be imagined. At this period, about 20,000 tons of iron were annually imported into England from abroad; and subsequently, when our manufactures increased, and before our own mines were properly wrought, the importation was still greater. In 1737, it was computed that England made annually at home about 18,000 tons of bar iron, which, at the rate of three tons of pig iron for one of bar iron, would give 54,000 tons as the produce of our mines. In 1783, a method was invented of converting pig iron into bar iron, superior to the Swedish bar iron; by which improvement it was given in evidence before the House of Commons, in the year 1812, when application was made for a parliamentary reward for the invention, that whereas, about 30 years before, the importation of foreign iron averaged about 50,000 tons, in 1810 it was reduced to 20,500 tons; and that our export of iron, which at the former period was only a few hundred weights, in 1810 amounted to 24,500 tons. From other documents laid before Parliament, it was ascertained, that our average import of foreign iron (principally bar iron) from 1800 to 1805, was 38,218 tons, of which 4590 were exported, leaving 33,628 tons for home consumption; and that the average of British unmanufactured iron exported from 1800 to 1805, was of bar iron 91,797 cwt., and of pig iron 40,186 cwt.: the increase between the beginning and end of that period was considerable, since in 1800 there was exported only 36,892 cwt. of bar iron, and 32,407 of pig iron; whereas, in 1805, there was exported of the former, 131,806 cwt., and in the latter 65,520. The average real value of pig iron exported from 1796 to 1805, was upwards of £14,000; and of bar iron, upwards of £29,000. At present, the iron mines of England are supposed to supply ore sufficient to produce considerably upwards of 150,000 tons of pig iron: 10,300 tons of which are made in Derbyshire, the remainder in Yorkshire, Staffordshire, Shropshire, Lancashire, Monmouthshire, &c. In the last county, there are nine furnaces, each of which makes about 2000 tons of pig iron yearly. At Mynythyr Tydvel, also, in Glamorganshire, there are furnaces for making pig iron, which produce 250 tons weekly, and consume 240 tons of coal daily.

Copper mines were first wrought in England in the year 1189: in 1561, mines of this metal were discovered in Cumberland; and, 1629, they were wrought in several counties. In 1690, copper was discovered in Wales, but it would appear, that during all this period, little attention was bestowed on working any of these mines; nor was it before the commencement of the 17th century that the valuable copper mines of Cornwall were properly and effectually wrought: and in a few years, the quantity produced had attained to a considerable amount. From 1726 to 1735, there was produced 64,800 tons of ore, which afforded the annual quantity of about 700 tons of fine copper. From 1736 to 1745, the ore amounted to 75,520 tons, producing 830 tons of fine copper. From 1746 to 1755, the produce of the former was 98,790, and of the latter 1080. From 1756 to 1765, 169,699 tons of the former, and 1800 tons of the latter; and from 1766 to 1775, 264,273 tons of the former, and 2650 of the latter;—thus exhibiting an increase in the produce of copper in 50 years, from 700 tons per annum, to 2650. About the year 1775, new copper mines were discovered in Derbyshire, which circumstance, added to the discovery of the famous copper mine in Anglesey, forms an important era in the history of this branch of English mining. As long as this latter mine continued productive, it furnished from 5000 to 10,000 tons per quarter, exclusively of what was obtained from the Mona mine, which probably was nearly as much; both together employing 1200 miners, and 90 smelters. But both the Parys and the Mona mines in some years produced comparatively little copper ore. In the mean time, the Cornish and Derbyshire ores were wrought with great spirit and success; so that the produce of them, and of the other mines in England and Wales, about the year 1791, had rendered this country one of the principal sources from which the world was supplied with this useful metal, instead of her depending, as formerly, upon foreign mines for a supply of it. It has already been shewn, that the Cornish mines in 1775, produced about 2650 tons a year: in 1798, the produce had increased to 5427 tons. At this time, the average annual cost of working them amounted to £313,589, of which the labour was £197,640, and the materials employed about 115,950: the number of men employed was about 5000, or perhaps nearer 6000. Within a very few years afterwards, the copper mines of Devonshire began to be wrought with spirit and success: in 1800 they did not produce more than 100 tons of fine copper: in 1804, the produce had increased to 300 tons. In 1805, owing to great exertions made in consequence of the high price of copper, the produce of the Cornish and Devon mines reached 7000 tons of fine copper, producing the amount of £1,260,000. At present, according to Mr Grenfell's Observations on the Copper Coinage, the Cornish and Devon mines yield 80,000 tons of ore annually; and the metal thus obtained being on an average from 5 to 15 in the 100th part, may be stated at 8000 tons of copper: almost all the ore is smelted in Wales. The consequence of this great increase in the produce of our own mines, notwithstanding the increased demand for copper, was visible in the diminution of our importation of this metal from foreign countries. In 1806, we imported, chiefly of copper ore, 43,600 cwt.: in 1807, upwards of 96,000: in 1808, 91,000: in 1809, 49,000: in 1810, 50,000: and, in 1811, only 20,000;—the ore itself having fallen from 73,800 cwt. which it was in 1807, to about 7000 cwt. in 1810.

In giving a historical sketch of the produce of the tin-mines in England, we shall not go farther back than the commencement of the 18th century. At this period, the mines, which had been neglected during the civil wars, were again wrought with effect and success, producing, one year with another, rather more than 1600 tons: From 1720 to 1740, the annual average...
produce was 2100 tons; from 1740 to 1750, 2500; from 1750 to 1760, 2658; from 1760 to 1770, 2728; from 1770 to 1780, 2750; from 1780 to 1790, 2958; from 1790 to 1800, 3245 tons. From the last period the mines seem to have been on the decline.

There is undoubted proof, that the lead-mines of this country, at least those in Derbyshire, were wrought in the time of the Romans, this metal having been exported A.D. 11; and at the time of the Conquest it was used to roof churches. In 1169, the exportation of it was carried to a considerable extent. During all this period, however, it would seem that no mines of this metal were known, or at least wrought, except those in Derbyshire. In the year 1299, lead-mines were discovered and wrought in Wales; and the circumstance being ascertained, that the ore of these mines produced some silver, increased attention and alacrity were given to the working of the mines of this metal. The produce of the lead-mines at present wrought in England cannot accurately be ascertained; those of Derbyshire are supposed to produce annually an average of between 5000 and 6000 tons, but to be on the decline; those on the borders of Cumberland and Northumberland are calculated to produce 150,000 pigs of 14 cwt. or 11,250 tons annually. The Cumberland employ upwards of 1000 men. The other metals which are found in England do not require any particular notice, except the black lead of Cumberland; the manganese of the Mendip Hills, and the zinc of Derbyshire. The first is of excellent quality, and in great demand for pencils, crucibles, &c. No more is wrought than is absolutely necessary to supply the demand, without lowering the price. The manganese of the Mendip Hills is become much more valuable than it formerly was, in consequence of the mode of bleaching by the oxidymuriatic acid, in which it is largely employed. The quantity of ore of zinc produced in Derbyshire, is about 500 tons annually. It is inferior in value to the calamine of Mendip. Besides calamine, blend, or black jack, another ore of zinc, but less valuable than calamine, is got in Derbyshire.

Salt pits.

The salt-pits of Cheshire and Worcestershire appear to have been wrought at a very early period; those of the former county are supposed by Mr Pennant to have been known to the ancient Britons; and the salt pits in Worcestershire were certainly wrought before the Conquest. In 1689, a license was given for making salt at Middlewich; but nearly 150 years after this, salt appears to have been so rare an article in England, that it was stipulated, that a quantity of it should be delivered annually by the king of France to this country. It is rather a singular circumstance, that though the brine pits were known so early, the pits of rock salt were not discovered in Cheshire prior to the year 1670. The quantity of rock salt made in Cheshire, seem rather to have declined within these few years. The annual delivery from the pits is between 50,000 or 50,000 tons, while the brine pits supply about 45,000 tons. At Droitwich, in Worcestershire, the salt made and sold in one year averages upwards of 600,000 bushels; of which, about one-sixth is sent abroad. The duty paid by the pits near this place, into the salt-office in London in the year 1771, was £61,457; at that time nearly one-third of the whole revenue from salt in England. The revenue from the salt made in Cheshire, however, is of so much more consequence, that a particular board is appointed for its collection and management, independent of the boards of customs and excise. It is estimated, that the home consumption of Cheshire salt is 16,000 tons, and the quantity exported about 140,000 tons. The following particulars will further illustrate the nature and extent of the produce of the salt pits in Cheshire and Worcestershire. In the year 1798, 816,731 bushels of rock salt were exported; of which, 651,820 were sent to Ireland, 54,900 to Germany, 49,800 to Russia, and 37,542 to Denmark. In the same year, 4,188,417 bushels of white salt were exported; of which, 910,782 were sent to Prussia, 895,430 to the United States of America, 676,629 to Russia, 407,152 to Denmark, 401,464 to Ireland, 306,103 to Germany, and 298,671 to British America. In 1799, the exportation of rock salt had considerably increased, the quantity being 1,336,025 bushels; of which, 394,975 were sent to Ireland, 167,600 to Denmark, and 163,317 to Prussia. This year the exportation of white salt had rather declined, the total exportation amounting to 4,192,182 bushels; of which, 1,234,027 were sent to Prussia, 1,036,617 to the United States, 549,560 to Russia, and 368,565 to Ireland. In the year 1800, the exportation of rock salt had again rather increased, the total quantity amounting to 1,977,571 bushels; of which, 760,549 were exported to Ireland, 510,582 to Prussia, and 173,098 to Russia. The exportation of white salt in 1800, was greater than it had been in either of the two former years, the total quantity being 4,538,542 bushels; of which, the United States took 1,436,085, Prussia 980,250, British America 551,958, and Russia 481,601. About 70,000 bushels are usually sent to Africa. It must be remarked, however, that the white salt includes what is made at the salt-pans, the principal of which are at Lymington in Hampshire, Sandwich in Kent, and on the coasts of Essex, Durham, and Northumberland. These we have mentioned here, from their connection with the subject of the salt mines, though not strictly in their place. The total number of salt works in the kingdom is between 180 and 190; and there are upwards of twenty refineries for rock salt. The salt sent coastwise during the year above specified, was as follows: British white, 5,631,562 bushels; of which, 3,827,510 were sent from Liverpool, 933,654 from the port of Gloucester, 293,512 from Bristol, 149,839 from Lymington, 146,983 from Hull, 116,948 from Sunderland, and 95,593 from Newcastle. During these years, 165,985 bushels of rock salt were sent coastwise, all from Liverpool. During the same years, 61,785 bushels of foreign white, and 32,50 of foreign rock salt were sent coastwise. The total consumption of salt by the inhabitants of England and Wales, is supposed to be 60,000 tons annually, besides what is used in the fisheries, for curing meat, &c. The statistical particulars connected with the quarries of this country are comparatively so minute and trifling, that we should not be disposed to enter upon them here, even if we had access to the requisite information; but, before concluding this part of our subject, it may be proper to add a few words respecting the pits of fuller's earth, from the immediate and important relation which this substance bears to our staple manufacture. We have already mentioned, that they are found in Bedfordshire, Berkshire, and Surry; a pit also has lately been opened at Maidstone in Kent. Although the demand for fuller's earth is not now nearly so great as it was formerly, in consequence of many of the clothiers using soap instead of it, yet there is still a considerable demand for it, especially for that which is procured in Surry. Mr Malcolm, in his agricultural account of that county, says, that he endeavoured to ascertain the annual consumption of the kingdom, and that, as nearly as might be, he found it to be about
ENGLAND.

Statistics. 6,300 tons; of which quantity, about 4,000 tons were sent from Surry. The price at the pit, in 1805, was about 5s. or 6s. per ton, whereas, in 1744, the price was 4d. per bushel, which is after the rate of 8s. per ton; a proof either that the supply had increased, or that the demand had diminished. Fuller's earth was deemed by the legislature of so much consequence to our woollen manufactures, that a special act was passed in the 28th year of the reign of his present Majesty, prohibiting the exportation of fuller's earth and fuller's clay, under a heavy penalty, and obliging the dealers and buyers of it to enter into bonds, to prevent its exportation; and certainly, whatever may be the opinion and practice now, the great and acknowledged superiority of English cloth was formerly ascribed, both at home and abroad, to the use of fuller's earth.

In estimating the amount of the national profit which is derived from our mines, &c. it is evident, that the mere profit derived by the individuals to whom they belong, even added to the net profit of those who lease and work them, will give us a very imperfect and inadequate notion of the increase which they bring to the stock of national wealth. In order to do this, we should be able to trace the raw produce of our mines through all its stages, till, by the wonderful effects of the unparalleled industry, skill, and capital of this nation, it appears in the form of the most useful or the most expensive articles of life. This, however, in most cases, it would be in vain to attempt, and, at any rate, where it is practicable, it would here be irrelevant, in a great measure, to our subject. We shall, therefore, conclude our account of the mining products of this country, with a tabular view of the profits from quarries, mines, and iron-works, derived by the proprietors, as returned to the House of Commons by the commissioners of taxes. It may be proper to mention, that though the report on the produce of the income-tax, accompanied with a particular statement of the profits from lands, &c. on which this tax was levied, was laid before parliament in 1812, it does not bring the details which we have extracted lower down than the 5th of April 1811.

Table III. Profits from Quarries, Mines, Iron-works, &c.

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<th>Iron works, &amp;c.</th>
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CHAP. IX.

Manufactures.

CAUSES OF THEIR SUPERIORITY.

Before we proceed to the consideration of the manufactures of this country, it may be proper to premise some remarks on the principal causes which have contributed, either directly or indirectly, to advance and extend them to their present state. This inquiry will not only be in a high degree interesting, but also important and useful; since, undoubtedly, if we can open up the causes which have produced the flourishing state of our manufactures, we shall, at the same time, explain and detect the causes of our national wealth and prosperity.

In the first place, much must be ascribed to the freedom of our constitution; for it would be in vain to attempt the regular and permanent establishment of any manufacture, where the lives and property of those who were to be engaged in it were not secure. At the same time, this position must be taken with some limitation, since the love of wealth with some, and the spirit of industry and enterprise with others, is so strong and overbearing, as to urge them on to risk their property, and the fruits of their industry, even under an unstable and tyrannical government. But certainly a free constitution, though not absolutely essential to a limited and trifling degree of manufactures and commerce, is a necessary requisite for their flourishing and permanent condition.

In the second place, the British government, though it is not by any means free from the charge of an interfering spirit with regard to commercial legislation, has, perhaps, less than most other governments, interfered in an abrupt and improper manner; and, indeed, it may justly be doubted, whether the interference of government, in all cases of trade and commerce, is so necessarily and clearly prejudicial to their interests and flourishing state, as has generally been imagined. There can be no doubt, that the protection and encouragement of government, like the protection and encouragement of individuals, may be beneficial to the exertion of human industry. It is not essentially and necessarily fatal to it, but only, so far as it is exerted in an improper manner, or at an improper time, or continued when circumstances render it expedient that it should be withdrawn. At any rate, whatever may have been the consequences to the nation at large, of the duties on foreign manufactures, and the bounties and drawbacks on home manufactures, which the British legislature has at various times, and on various occasions, enacted, in obliging them to purchase the latter when they could have procured the former at a cheaper rate, there can be no doubt, that these enactments have contributed to the present flourishing and extended state of our manufactures and commerce.

MACHINERY.

In the third place, infinitely more must be ascribed to our improvements in machinery, and our consequent saving of labour, than to either of the preceding causes; though, if we trace this cause up to its source, we shall find, that these improvements in machinery, and this saving of labour, would not have taken place, unless the manufacturers had been protected by a free government; and probably not unless they had been further protected by duties on foreign goods, and bounties and drawbacks on their own. But whatever may have been the disposing causes of these improvements in machinery, by which so much labour is saved, there can be no doubt, that to them we should mainly ascribe the flourishing state and extent of our manufactures at present. It is sufficiently obvious, that men will prefer those articles, whether of necessity, comfort, or luxury, which are offered to them at the best quality, and at the cheapest rate; and it is equally obvious, that cheapness of price must depend, in a great measure, on the smallness of the quantity of labour by which they are produced, or on the low rate of wages or mercantile profit. The low rate of mercantile profit will afterwards be considered; but with respect to the low rate of wages, it may be remarked, that where it exists, the workmen are dissipated, and by no means disposed to exert themselves with that industry, attention, and skill, which are requisite to produce articles of a superior quality; but, by the introduction of machinery, though the rate of the workmen's wages is high, the actual sum of wages which enters into the price of any article is very low: Thus machinery at once enables the manufacturer to sell his goods cheaper, and to continue the same rate of wages, or perhaps to increase it, to his work people.

In the fourth place, the immense capital possessed by the manufacturers of this country must be regarded as one cause of the flourishing state of our manufactures. This acts, in many respects, in the same manner as machinery; by enabling the possessor of it to buy his raw material cheaper than he could otherwise do, it enables him to sell it cheaper. He can also afford to give longer credit, which is, in fact, to sell goods cheaper. But the most striking analogy between the effects of large capital and of machinery, remains yet to be pointed out and explained. We have just seen, that where machinery is used in the manufacture of goods, the value of the labor which enters into the price of these goods is much diminished, though the wages of the labourers continue the same; in like manner, when a manufacturer is possessed of a large capital, the rate of profit which he derives from the sale of his goods may be diminished, and yet his actual profit may remain the same; so that he can, by means of his capital, afford to sell his goods cheaper, and yet derive the same pecuniary benefit from his trade, which he did before his capital was increased. It is obvious also, that as the possession of a large capital is necessary to the erection and maintenance of machinery, and to the payment of the numerous labourers which it requires, capital, in this view of it, may be regarded as contributing to a diminution of price, and to superiority of quality, and consequently to an extension of demand, of trade, and of profit.

In the fifth place, the division of labour is carried much further in this country than in any other part of the world; on the consequences of this, so far as regards dispatch and dexterity (whatever may be its effects on the mind,) it is unnecessary to enlarge.

Lastly, besides these causes of the present flourishing state of the manufactures of this nation, all of which have been frequently pointed out and explained, there seems to us to be another cause which has not been sufficiently attended to and appreciated, in considering this subject. It is, we believe, generally admitted, that an English labourer will work with much greater and longer continued exertion than the labourers of most other nations. In two respects he is superior to them: in the first place, he possesses more activity and energy, both of body and mind, than the labourers of those nations who can plod at their work with equal steadiness, and for an equal length of time; and in the second...
place, he more than compensates for that superior quickness and agility of body and mind, which the labourers of France and some other countries display, by the steady and unremitting nature of his exertions. Such is the character of the English labourers in general; but it is obvious and natural, that this character will not display itself fully and permanently in action, unless there are circumstances sufficiently powerful to bring it forth; or, in other words, that the English labourer, like all other men, requires a powerful stimulus to induce him to work, with all the activity, energy, and steadiness of which he is capable. It was therefore desirable that his reward should be in exact proportion to his services; but in the case of his being paid by the day, this could not be the case, as his reward then was in proportion to the time he was employed, not in proportion to the quantity of work which he performed. Accordingly it was the interest of the master to pay his workmen by the piece; nor was it less their interest to accede to this proposition, since thus they were enabled to acquire more wages than they could possibly do when paid by the day. This system of task work, so common in almost all the branches of our manufactures, must therefore be considered as one of the causes of the cheapness, if not of the excellence, of the articles they produce; since, where a master pays his workmen in this manner, he is certain of getting a greater quantity of work done for the same money than if he had paid them by the day, and consequently can afford to sell his goods at a cheaper rate; while the workmen, feeling a more direct and deep interest in what they are about, will work with more spirit and enterprise.

Such appear to us to be the principal causes of the superior quality, the cheaper rate, and the wonderful variety, extent, and prosperity of our manufactures. Other causes may, and do undoubtedly exist and operate, but they are either partial, and confined to some particular branches of manufactures, or they may be traced up to those which we have just enumerated and explained.

Sect. I. The Woollen Manufacture.

Having premised these remarks, we shall now enter on our view of the manufactures themselves, beginning with the woollen manufacture, as the most ancient, and probably even yet, notwithstanding the rivalry of the cotton manufacture, the most extensive and valuable.

The introduction of the fabrication of woollens was undoubtedly owing to the Romans, who persuaded the rude and savage inhabitants of this island, not only to exchange the skins in which they had hitherto been clothed for the more comfortable attire of their conquerors, but also to turn their attention to the art of weaving. A manufacture was established at Winchester of sufficient magnitude to supply the Roman army; and there is reason to believe, that, while the Romans remained in possession of this island, this manufacture was continued. From the period of their quitting it till the commencement of the tenth century, there are not any evidences, either direct or indirect, by means of which we can judge of the state of the woollen manufacture; but at the latter period, from the prices of wool which are mentioned as the current rate of the fleece, there is reason to suppose that the article was cultivated with considerable attention. About the year 925, a fleece was valued at two-fifths of the whole sheep; a proportion much greater than that which it bears at present, and which proves, either that the demand for the carcass was much smaller, or that for the fleece much greater than it is in our own times. The value of the sheep continued nearly the same for some hundred years, while wool at the same time advanced in price, and continued to do so through the space of two centuries. The difference in value between them was very striking in the year 1135, at which time the price of sheep had declined 50 per cent, and the price of wool had advanced nearly as much. The demand for fine cloth, which seems to have been pretty general among the nobility in Henry II. time, led to the introduction of Spanish wool; but this was soon prohibited by a statute, which was framed for the encouragement of the British farmer, and the improvement of his wool. About the year 1240, the importation of fine cloth began to be encouraged, the consequence of which was, that English wool, being in some measure deprived of the home market, was sent abroad to Flanders, where it was manufactured. This kind of traffic subsisted about 100 years without interruption; till about the year 1330, the English began seriously to encourage the manufacture of woollens among themselves; and the mode which they adopted for that purpose displays a liberal and sound policy, very creditable to the times.

Sensible of the superior expertise of the Flemings, they tempted them to come over and settle in this country; their success and the improvement of the English was so great, that the legislature very soon began to imagine that the English fabrics were extensive enough to consume all the wool in the kingdom, and a law was accordingly passed totally prohibiting its exportation. The consequence was such as might have been anticipated and expected. Our fleece, which the regular demand from the Netherlands had increased in quantity, and greatly improved in quality, suffered in both respects. The surplus of wool appears from the time of Henry II. to that of Edward III. to have constantly increased, and the exportations as regularly took it from the hands of the grower, who, finding that he obtained a higher price in proportion to the goodness of the quality, turned his attention to the improvement of his fleece. Afterwards, when the woollen manufacture was established at home, it also exerted its natural influence on the quantity and quality of our wool; for the flocks in the southern part of the island, where the manufacture was most attended to, were in the best condition, and the quality of the staple most desirable.

Having thus briefly traced the woollen manufacture of England to the time of Edward III. when it may be said to have gained a firm footing in this country, we shall now content ourselves with giving some few detached historical notices concerning it, previously to entering on an account of its present state. It does not appear that the original seat of this manufacture was either in the west of England, or in Yorkshire; by some, Kendal is supposed to have been the first town where it was established; but the more probable opinion is, that the Flemings, brought over by Edward III. were fixed at Cranton, in Kent. In the beginning of the 16th century, however, the north of England was distinguished for this manufacture; for in 1520, it is recorded, that there were three famous clothiers living in the north country, viz. Cuthtbert of Kendal, Hodgskins of Halifax, and Martin Brian of Manchester, each of whom kept a great number of servants at work, spinners, carders, weavers, fullers, dyers, &c. Towards the middle of this century, Manchester, Lancashire, and
England.

Cheshire, are mentioned in an act of Edward VI. as famous for their cotton goods, which were, at that time, a species of woollen cloths. We have only a traditionary account of the place from which the woollen manufacture was introduced into that part of Yorkshire where it now flourishes; and this tradition reports, that it was brought thither out of Devonshire, where it had been settled by some workmen from Flanders. Rippon seems to have been one of the towns in Yorkshire, into which it was first introduced; but, according to Wright, in his History of Halifax, it was removed to the latter place for the sake of the advantage of the coals and water. During the infancy of this manufacture, the legislature interfered in it, not only by prohibiting the exportation of the raw material, but also by limiting and expressly naming the particular towns, both in the north and west of England, in which it was to be carried on. In 1534, the woollen manufacture in Worcestershire was conferred to five towns. In 1551, if we may credit the accounts, the Hanse merchants exported from this country 44,000 pieces of cloth, and the English manufacturers 1400 pieces; and a very few years afterwards, above 200,000 pieces were sent to the Netherlands. In 1614, a great improvement took place in the woollen manufacture of the west of England, by the invention of what is called medley or mixed cloth, for which Gloucestershire is still famous. At the end of this century, the total annual manufacture of woollen was estimated at L.8,000,000. In 1739, the author of Considerations on the running of wool, gives an estimate of the number of people employed in the woollen manufacture, rating them as high as 1,500,000, and, "if these earn, (he adds,) one with another per day, for 313 working days in the year, their wages will amount to L.11,757,500." This author, however, must have greatly overrated the number of people employed, since the wages of labour in this manufacture, at present, when the price of labour is at least four times as high as he takes it at, will not reach that sum. In the year 1770, it was proved, by documents laid before Parliament, that the official value of the woollen goods exported, amounted to more than L.4,000,000. From 1772 to 1776, the exportation seems not to have increased, as it appears from an account of the value, as rated in the inspectors' books, of all the woollen goods of all sorts, viz. bays, cloths, cottons (coating), flannels, serges, says, stuffs, stuffs mixed, carpets, and worsted stockings, that the amount of the whole of these articles exported from England, in 1772, was L.4,436,783; in the year 1773, L.3,975,929; in the year 1774, L.4,333,583; in the year 1775, L.4,280,173; and in the year 1776, L.3,868,053. At this time, as is the case at present, a much greater value of woollen manufactures was shipped from London than from all the other ports of England. In the year 1775, when the export of London was much less than in some other years, the value of woollens shipped from London was L.2,947,570; and from the exports, only L.1,978,602. As far as we are able to judge of the increase in our woollen manufactures from the quantity exported, it does not appear to have been considerable from the end of the 17th century till the year 1777, as will appear from the following statement of the value of the exports of it, at the former period.

In 1698, from London, L.2,102,634; and from the outports, L.1,017,981; total, L.3,120,615.

In 1700, 2,021,145; ... 903,018; ... 2,989,108.

In 1701, 2,045,961; ... 1,082,414; ... 3,128,365.

In 1789, a pamphlet was published, containing an estimate of the annual produce and condition of the principal manufactures of this country, in which the woollen manufacture was rated at L.16,500,000; but the data on which the author builds this calculation are not given. About this period, the demand for fine cloths seems to have been increasing, for in an account of the quantity of the principal articles imported and used in the manufactures of Great Britain, on an annual medium of five years, commencing 5th January, 1772, laid before Parliament, it appears, that from the year 1772 to the year 1776, the annual medium quantity of Spanish wool imported was 1,578,605 lbs.; and in the period of five years, ending 1787, the annual medium quantity was 1,975,327 lbs. The account was continued down to 1799, and it proved a greater rate of increase in the quantity of Spanish wool imported, during the two next series of five years, than before, on an annual medium from 1787 to 1792, 3,174,429 lbs.; and on an annual medium from 1792 to 1799, 3,880,583 lbs.

In the year 1799, an account of the total value of the woollen manufactures exported, agreeable to the estimate of the inspector-general's books, (and consequently at least 50 per cent. below the real value,) during the ten years preceding, was laid before Parliament; from this account, it appears, that the official value of these manufactures, during 1790, was L.5,190,637; during 1791, L.5,605,034; in 1792, L.5,510,668; in 1793, L.3,806,536; in 1794, L.4,399,920; in 1795, L.5,172,884; in 1796, L.6,011,133; in 1797, L.4,926,555; in 1798, L.6,499,399; and in 1799, L.6,860,939. The effect of the first year of the war is very visible in the diminution of the value of the exports for 1793. As this account gives the value of woollen manufactures exported to each different country, it affords a further insight into the state of the export woolen trade during this period. By far the greatest quantity every year appears to have been exported to the United States; in 1790, the value of the exports this year was L.1,481,376, and in the year 1799, L.2,933,490. Before the commencement of the war, Spain and Portugal seem each to have taken, to the amount of between L.500,000 and L.400,000, and Holland nearly an equal quantity. Ireland, in 1790, took to the value of L.1,894,790, which increased till the year 1793, when the value was only L.178,071. In the year 1794, the value again rose nearly to what it was in 1791; and continued to increase to the end of the period, it being in 1799 as high as L.916,190. The value of the woolen goods exported to India, (probably nearly all the manufacture of the west of England) varied, during this period, between L.892,500 and L.668,161. France, before the war, does not appear to have taken, on an average, woolen goods to the amount of L.100,000 official value.

In the month of April 1800, the principal manufacturers of woolen goods in Yorkshire, and in the West of England, were examined before a committee of the House of Commons relative to the state of that manufacture: We shall, in the first place, give the results of their evidence on this occasion, and afterwards offer some remarks upon it; premising, that where no prejudices or interests intervene, to conceal, exaggerate, or distort facts, more information is to be got, on the ma-
manufacturing and commercial state of the kingdom; from evidence given before Parliament, than from any other source, or by any other means; since no otherwise can access be had to the information, experience, and opinions of so many persons, who must necessarily be so extensively, accurately, and minutely informed, on the subjects on which they give their evidence.

The first point to which the evidence of the manufacturers examined before the committee of the House of Commons relates, is the number of sheep kept in England and Wales; these they estimated at 28,020,000; and the produce of the fleece from these sheep, they rated at 600,000 packs, of 240 lbs. each pack. Some of the witnesses, however, were of opinion, that the number of sheep, and consequently the produce of wool, had diminished between the year 1784 and the period of their examination. On the supposition that the number of packs was 600,000, they rated the total value of the wool in the kingdom at £6,600,000, being at the average price of £L.11 per pack. The next point to be ascertained respected the increase of the value of the raw material, after it was manufactured. This increase evidently varied very much; in some kinds of goods it was double only, while in other species of goods, the increase was ninefold. As the quantity of goods, in which the former rate of increase took place, consumed a much greater proportion of the raw material than the latter, the increase was supposed, on an average, to be threefold. According to this supposition, the total value of woollen goods manufactured in the kingdom amounted to £L.19,800,000. Having thus ascertained these points, or at least gained the opinion of intelligent and experienced manufacturers respecting them, it next became a question of considerable importance to determine the number of people engaged in this extensive manufacture. On this head, the evidence is not so distinct and satisfactory; we are merely informed, without any detail being entered into, or any satisfactory calculations given, that the woollen manufacture was supposed to give employment to three millions of men, women, boys, and girls: this astonishing number was given in evidence, as being actually employed, though at the same time, it was admitted, that, by the use of the machinery in the various processes previous to the weaving, 35 persons were enabled to do the work, which about the year 1785, when machinery had not been introduced into the woollen manufacture, required the labour of 1694 persons. It is evident, that, through the introduction of this machinery, the quantity of human labour necessary to manufacture the woollen goods was diminished, yet the capital requisite to carry on the manufacture must have been considerably increased; and it was given in evidence, that the capital vested in machinery and buildings appropriated to the woollen manufacture, was, in the opinion of the witnesses, supposed to be nearly equal to the value of the raw material, or £L.6,600,000.

Such was the evidence given respecting all the various branches of manufacture in which wool was employed; with regard to the woollen manufactures of the West Riding of Yorkshire, which at all times have been the most important and extensive in the kingdom, it was given in evidence, that there were employed in it 78,734 packs of wool, at that time worth £L.11 a pack, and consequently, on the whole, worth £L.800,074; and that from this quantity of wool, there was manufactured 278,755 pieces of broad cloth, which, at about £L.13, 18s. the piece, were of the value of £L.3,795,157. It was further stated, that there were 38,028 packs used in the woollen manufacture of the West Riding of Yorkshire, of the average value of £L.14 per pack, which were manufactured into 180,168 pieces of narrow cloth, the average value of which was £L.6 a piece, and consequently the total value of this species of cloth was £L.1,081,008, making the total value of broad and narrow cloths to be £L.3,876,165. The value of the kerseymeres, blankets, and other goods, was rated at £L.1,000,000; and the value of the stuffs, or worsted goods, at £L.1,400,000; the whole woollen goods manufactured in the West Riding being thus estimated at £L.7,876,165; or about 10/11 of the value of the woollen goods manufactured in the whole kingdom.

Now, with respect to this evidence, so far as it relates to the woollen manufacture of England and Wales generally, we are afraid that it is erroneous on two of its principal and leading points. In the first place, it appears to us, that the number of sheep is over-rated, and consequently the quantity of wool. On this mistake we need not enlarge, since we have already endeavoured to prove, by enquiring into the number of sheep, and the produce of the wool in each separate county in England and Wales, that the number of the former is rather more than 26,000,000, and the quantity of the latter rather more than 393,000 packs. In the second place, it appears to us that the number of people stated to be employed in the woollen manufacture of the whole kingdom, is also greatly over-rated. We have seen that the value of the woollen goods manufactured in the West Riding of Yorkshire, was about 1/11 of the value of the woollen goods manufactured in the whole kingdom; now, if we suppose that the number of hands employed in the West Riding at that time, bore the same proportion to the hands employed in the whole woollen manufacture, that the value of the goods did, there must have been upwards of 1,100,000 people employed in this part of Yorkshire, that is nearly twice the number of inhabitants which it then contained. But let us try this point another way: the value of the whole raw material was estimated at £L.6,600,000: the value of the whole manufactured goods, at £L.19,800,000, leaving £L.13,200,000 for interest of capital, manufacturing profit, and the wages of labour. We cannot estimate these at less than 20 per cent. on the sum thus reduced, which will make them amount to the sum of £L.2,640,000; leaving the sum of £L.10,560,000 for manufacturing wages, which, if there were 3,000,000 of people among whom it were to be divided, would give, as the wages of each individual, little more than £L.3 per annum; but as we cannot average the wages of men, women, boys and girls, at less than 6s. 8d. a week, or about £L.17 per annum, we must suppose that the number of people employed did not amount to more than 550,000, a number much more probable than the former. It may also be remarked, that the calculation is made at too high a price of wool; the average price for three or four years preceding 1800, being not more than from ten pence to ten guineas. For these reasons, some authors who notice the result of this evidence, not only reduce the quantity of wool from 600,000 packs to 500,000, (a quantity which we have shewn to be still too great,) but also form the calculation of the value of the wool manufactured in 1800, at £L.10,10s. per pack, making the total value £L.5,250,000. But, if the manufacturers examined on this occasion, erred in estimating the quantity and value of English wool too highly, they also erred on the other hand, in not taking into their account the value of Spanish wool imported, which
at least amounted to £500,000; this, added to the former sum, will make the total value of the raw material £2,750,000 and supposing the manufactured value to be thricefold, the total value of woollen goods will be £1,175,000.

Mr Grellier's statement examined.

We should not have thought of dwelling longer on the state and extent of the woollen manufacture at this period, had we not observed, that the late Mr Grellier, who was deservedly celebrated for the attention he paid to statistical enquiries, differs from us in various points respecting it. This circumstance, joined to the consideration, that if we can determine the state of the woollen manufacture in 1800, we shall be the better able to ascertain its state at present, or at least to form a comparison between its state at the two periods, induces us to add a few observations, which, in our opinion, will point out the instances in which Mr Grellier is mistaken. In the first place, he gives it as his opinion, that the real value of the woollen goods exported is only about 38 per cent. above the official value; but this is certainly a mistake, and we observe in the report on the state of the woollen manufacture, in 1805, that the committee, mentioning the very great national importance of this manufacture, state the official value of the exports to be £6,000,000; and expressly add, or £9,000,000 actual value. In the next place, Mr Grellier deduces from the gross amount of the value of the manufactured goods only 10 per cent. for the profits of the manufacturer, including the interest of his capital; but a little reflection must serve to convince us, that 10 per cent. on the gross value, is too small a sum; and that 20 per cent. on the sum which remains, after subtracting the price of the raw material from the gross value of the manufactured articles, is nearer the truth. In the last place, Mr Grellier, taking all classes of work people, in the woollen manufactures, together, estimates their wages at 8s. per week; and by this high rate of wages, and a reduction in the value of the whole manufactured goods, notwithstanding he allows less to the master manufacturer himself, he reckons the whole number of persons employed only at 440,330. But when we reflect on the large proportion of women, boys, and girls, that are employed in this manufacture, and at the lowness of the wages, especially of the two last, we shall be disposed to consider his average rate as too high, at least for the year 1800; and moreover, when we consider, that in many of the manufacturing parishes in the West Riding of Yorkshire, one-half or two-thirds of the people are employed in the woollen trade; that the population of the whole Riding, in 1800, was upwards of 560,000; and that the amount of the value of the woollen goods manufactured there was only ½ of the whole goods manufactured in the kingdom, we shall be disposed to estimate the number of people employed in this manufacture at considerably more than 440,330. At the same time it must be admitted, that on this as well as on many other points of statistical enquiry, the data are too few, or too questionable, on which to ground accurate and perfectly satisfactory results.

Having thus brought the historical sketch of our woollen manufacture, considered generally, down to the commencement of the present century, we shall now proceed to consider the principal branches of it; the districts or towns in the kingdom which they occupy; and their actual state.

Under the general head of manufactures of wool, we comprehend not merely what are strictly and properly denominated the woollen manufactures, but also all manufactures in which wool is the raw material employed; these are naturally divided into the manufacture of woollen and of worsted goods; or into those goods in which the card or the comb are employed in the preparation of the raw material.

The principal seats of the former kind are the West Riding of Yorkshire, and the western counties of Wales, Somersetshire, and Gloucestershire; and of the latter kind, the county of Norfolk; for we shall omit the consideration of the stocking manufacture at present, and consider it by itself, as stockings, being made of worsted, cotton, and silk, seem properly to fall under none of these heads. The woollen manufactures of North Wales will also be considered; they are principally situated in the counties of Merioneth, Denbigh, and Montgomery.

The length of the manufacturing district of the West Riding of Yorkshire, from north to south, may be estimated at 40 miles, and its mean width at 20 miles, giving together an area of 200 square miles; but this space includes the hardware manufacturing district about Sheffield, as well as the clothing district: the latter commences below Craven, and extends over a tract, of which Leeds, Bradford, Halifax, and Wakefield, are the principal centres. The most important manufacture in this district is that of woollen cloth, the greatest part of which is made in the neighbourhood of Leeds, Wakefield, Huddersfield, and Saddleworth. Leeds is particularly the mart for the coloured and white broad cloths. The former are sometimes called mixed cloths, and are made of dyed wool. The mixed cloth manufacturers reside partly in the villages belonging to the parish of Leeds, but chiefly at Morley, Guisborough, Adwalton, Dudlington, Pudsey, Parsley, Calverley, Eccleshall, Idle, Baildon, Yendal, Gisley, Rawdon, and Horsforth, in or bordering upon the vale of Aire, principally to the west of Leeds; and at Batley, Dewsbury, Osset, Horbury, and Kirkburton, west of Wakefield, in or near the valley of Calder. Very few mixed cloth manufacturers are to be found to the east and north of Leeds, and there are very few in the town itself. The white cloth is manufactured chiefly at Alverthorpe, Osset, Kirkheaton, Dewsbury, Batley, Birstall, Hopton, Merfield, Kirkheaton, Little-town, Bowling, and Shetley, a tract of country which forms an oblique belt across the hills that separate the vale of Calder from the vale of Aire, beginning about a mile west of Wakefield, leaving Huddersfield and Bradford a little to the left, terminating at Shipley on the Aire, and not coming within less than six miles of Leeds on the right. The districts of the mixed and white cloth are in general distinct and separate, but in some places, particularly at their south-east and south-west extremities, they run into each other. The principal manufactures of woollen in and near Halifax, are flannels and baizes; though cloth, especially of that kind which is used for the army, is very generally made. The blanket and flannel lines lie between Leeds and Huddersfield; and the manufacture of stuffs, principally in the neighbourhood of Bradford and Halifax: narrow cloths are made in and near Huddersfield. At Saddleworth, the manufacture of broad cloths, nearly equal in fineness to those of the west of England, and of kerseymeres, is carried on. At Wakefield some white cloths are made; but this place is principally distinguished for its wool market, and for the excellence of its mode of dyeing cloths.

The county which first claims our attention in the west of England, for its woolen manufacture, is Gloucestershire.
esteshire; here broad cloths of various sorts are made, but chiefly superfine, of Spanish wool; and of fine narrow goods, in the fancy way, to a very great extent. This manufacture is carried on in that district— which, by way of distinction, is called the Bottoms, including parts of the several parishes of Avening, Painswick, Pitcomb, Randwick, Minchinhampton, Stroud, Bisley, Rodborough, Stonehouse, King's Stanley, Leonard Stanley, Wood Chesters, Horseley, and Eastington; extensive works are also carried on at Durley, Can, Uley, Alderley, Wickwar, and Wooten-under-Edge. Stroud may be considered as the centre of the manufacture in this part of the country, all the surrounding valleys exhibiting a range of houses or villages, inhabited by persons engaged in this business.

In Wiltshire, the principal manufactures of woollen cloth are Bradford, which is considered the centre of the greatest fabric of superfine cloths in England, which it shares with the surrounding towns of Trowbridge, Melksham, Corsham, and Chippenham; besides these places, woollen cloth, of a thin texture, is made at Wilton; and cloths of various qualities, but all fine, are made at Warminster, Calne, and Devizes.

The principal places in Somersetshire, where this manufacture is carried on, are Taunton; here the woolen goods are principally of a coarse fabric: Frome and Shippon Mallet; the former is famed for its manufacture of second cloths, the latter for superfine, of which it generally makes annually between 150,000 and 200,000 yards. The woollen cloths made in the west of England are commonly arranged into five classes, according to their thickness: the thickest are double superfine milled; the finest and thinnest cloths are for the Turkey trade; ladies cloths are rather thicker than these; cloths manufactured for the East and West Indies, a degree thicker; and the superfine are, in point of thickness, next to the double superfine already mentioned. The woollen manufacture of the west of England also extends into parts of Dorsetshire, Sturminster Newton in that county being famous for its broad cloths and flannels.

In these two grand seats of the woollen manufacture of England, the West Riding of Yorkshire, and the counties of Gloucestershire, Wiltshire, and Somersetshire, there are three different modes of carrying it on: 1st, That of the master clothier of the west of England; 2d, That of the factory system; and 3d, That of the domestic system. The last was undoubtedly the original, and formerly the most prevalent and extensive system, though the state and circumstances of society, and especially the improvements in machinery, have at present confined it within narrow limits. It is to be found principally a few miles below Leeds, and 14 miles to the south of it. It does not extend far from Leeds in the other directions. It is also found nearly at the same distance round Huddersfield. The factory system, however, is daily encroaching on the limits of the domestic system, and, without doubt, will in time totally extinguish it.

Through the whole of the west of England, as well as in the north of England, there are factories; but the master clothier of the west of England buys his wool from the importer, if it be foreign, in the fleece, or from the wool stapler if it be of domestic growth; and in all the distinct processes employs distinct classes of persons, who work either at their own houses, or in the factories of their master. None of those workmen go beyond their own peculiar branch of the manufacture. From this circumstance, and the necessary consequence of it, that each is excellent and perfect in his own line, it is superseded that the superior excellence of the west of England cloth arises. Previously to the introduction of machinery, it was common for the north country man to come into the west of England, purchase wool, work it up in Yorkshire, and sell it in its manufactured state in its native country. This circumstance was supposed to arise from the north country man being at liberty to work himself, and employ his family and others as he pleased. In the factory system, the master manufacturer, who sometimes possesses a large capital, employs a number of workmen in one or more buildings or factories under his own inspection, or that of his superintendents. It is evident that, both in the system of the west of England, where the master clothier gives the raw material to workmen, who manufacture it either in their own houses or in factories, and in the factory system of the West Riding of Yorkshire, the workmen have no property in the goods which they manufacture. This circumstance marks the essential difference between these systems and the domestic.

The domestic system, as we have already mentioned, still exists in Yorkshire, though not to nearly so great an extent as formerly. It is also found in Devonshire, and in the manufacture of woollen cloth, in Wales, and in a small village in Cambridgeshire; but it is with it as it exists in Yorkshire that we are now interested. According to this system, the manufacture is conducted by a number of master manufacturers, generally men of small capital, who, besides carrying on their manufacture of woollen cloth, have small farms of a few acres, partly for the support of their families, and partly for the convenience of their manufacture. The domestic clothiers have sometimes one loom, sometimes two or three, but seldom four looms in their houses, at which they themselves, their wives and children, and from three to seven journeymen, are generally employed: during harvest, their wives, children, and servants, are sent out to work. They buy their wool of the dealer, and formerly used to carry it through all the stages of its manufacture, and even dye it; but at present they make use of the mills and machinery, which may happen to be in their neighbourhood, for many of the processes, as there are public mills near every manufacturing village. If the distance of the domestic clothier from these mills be considerable, or if he is obliged to go farther for a market for his cloth, he generally keeps a horse, which is supported on his little farm. As there is coal in all the district where the domestic system is principally carried on, which may be about from 20 to 30 miles long, and from 10 to 15 broad, the domestic clothier easily and cheaply obtains this article, so necessary for his own comfort, and for the conducting of his business.

By the natural operation of very obvious causes, the domestic clothiers are gradually forced from the vicinity of large towns, since near them land rises in price much sooner, and to a greater degree than at a distance from them; and it is a great convenience, if not absolutely necessary, for the domestic clothier to have a small portion of land attached to his cottage.

The establishment and extension of the factory system naturally excited the fears and jealousy of the domestic clothiers; and, in order if possible to put a stop to it, in 1806 they applied to parliament to put in force the laws respecting apprentices, and the number of looms. The first law was passed in the time of Queen Elizabeth, at a time when the number of our distinct trades was not above 100, whereas now they are between 600 and 700. The factory system creating a
great demand for manufacturers, induced the proprietors of large factories to take many who had not served the legal length of apprenticeship; whereas the system of apprenticeship being more congenial to the domestic system, those who followed this system had no temptation to break the law. The other law, which, in their petition to parliament, the domestic clothes wished to be enforced, is commonly called the weaver's act. It was passed during the 2d of Philip and Mary, and in certain cases, and parts of England, limits the number of looms in one building; but on their application to parliament, it was shown that this act does not extend to Yorkshire, Northumberland, Cumberland, or Westmoreland. The petitioners also wished, that the statute of the 5 and 6 of Edward VI, which they contended applied to the gig mill, should be put in force. Of this statute, the committee, in their report on the evidence, recommended the abolition.

From the report and evidence on this occasion, the following facts and circumstances may be selected, as illustrating the state of the woollen manufacture in general, and especially in the West Riding of Yorkshire.

The acts of parliament relating to this manufacture, which are still on the statute book, amount to nearly 70, and may be divided into three classes: 1st, Laws for regulating the conduct of masters and workmen, and for preventing fraud and embezzlement by journeymen, &c. These in general are wise and salutary, particularly one passed in the 29th Geo. II. by which masters are prevented from paying their workmen in goods, 2d, Laws prohibiting the exportation of certain materials and implements, all of which have been passed in the reign of his present Majesty; and 3d, Laws which control the manufacturer in making and selling his cloth, particularly those which prohibit the use of certain articles of machinery. Among those may be included the law respecting apprentices, and the weaving act already mentioned.

The committee, in their report, pointed out what in their opinion were the advantages and disadvantages of the domestic system, as distinguished from, and contrasted with, the factory system. According to them, one peculiar recommendation of the domestic system is, that a young man can always obtain credit for as much wool as will enable him to set up as a small master manufacturer, while the public millenable him to command the use of very extensive machinery. Another advantage of this system is made manifest, on the failure of a market for any particular kind of goods; since where this system prevails, it does not throw a multitude out of employment, as it does when the stroke falls on the capital of a great individual. In the domestic system the losses spread much, and it is remarked, that the domestic clothiers seldom turn off their journeymen. On the other hand, the domestic clothiers necessarily waste much time in carrying their goods to the fulling mills, &c. which might be saved, if the factory system, in which all the operations are carried on under one roof, were adopted.

Perhaps, however, the most important point of view in which these systems can be contrasted, respects their influence on the morals and habits of the people; and there can be no doubt, that if the distinguishing excellence of the English character results in a great measure from their domestic habits, or if domestic habits are favourable to propriety and steadiness of conduct, the domestic is preferable to that of the factory system. Viewed in this light, which however is more the object of the moralist than of the statistical enquirer, the domestic system of Yorkshire, in which the manufacturer not only works at home in the midst of, and in company with, his family, but also on goods entirely his own property, is undoubtedly the most valuable and useful. Next to this must be placed the system, common but not universal in the west of England, according to which the workmen work at their own houses, but on goods not their own property. Here the domestic habits and their consequences may be the same as are produced by the first system; but that feeling which arises from the consciousness of the possession of property, which not only stimulates to industry, but also keeps up regular habits of conduct and independence of mind, must be wanting. In the scale of the moralist, the factory system must stand lowest, though, as applied to the woollen trade, it is not so dangerous to the best interests of society, as when applied to the cotton trade. The causes of this we shall afterwards attempt to point out, when we come to compare the state of the manufacturing population of the woollen and cotton districts.

Besides the difference in the mode of conducting the woollen manufacture, which we have explained at considerable length, there is also a difference between the Yorkshire and the west of England mode of disposing of the goods when manufactured. In the latter, they are principally sold at markets or fairs; in the former, they are principally sold in what are called cloth-halls, and which towns have three or four cloth-halls at Bradford, Halifax, Huddersfield, Wakefield, &c. We shall confine our observations to those of Leeds, and to the mode of conducting business in them.

The two principal halls in Leeds are for mixed and white cloth. They are principally distinguished from the third hall, (which was erected about 1795,) by not admitting any manufacturers to expose their goods in them, who have not served an apprenticeship to the woollen trade. Formerly a regular apprenticeship of seven years was insisted on; but now five years are deemed sufficient. The mixed cloth-hall was erected in the year 1758. At first they were only 1557 stands, but afterwards 171 were added, making the total number 1728. The original price was £3, 5s. 6d.; but they have advanced greatly since. The price, however, varies according to the state of the trade. There are seldom fewer than 7000 pieces of cloth, and sometimes nearly 20,000 weekly in the coloured cloth-hall.

The white cloth-hall was built in 1773. The number of stands is upwards of 1200; but there are many manufacturers who have two stands each. In the district round Leeds, it is computed that there are 3500 masters who attend both halls; but there are many who have no stands in either hall, but pay 6d. for every fresh cloth; when a cloth has once paid, it does not remain, but may be removed to any other part of the market. There are 15 districts belonging to the coloured, and 17 to the white hall, over each of which there is a trustee, who manages the affairs of the district; and in all of whom is lodged the power of directing whatever concerns the halls. These trustees are elected for three years.

These halls consist of long walks or galleries, throughout the whole length of which the master manufacturers have their stands in double rows, each behind his own little division; his goods being exposed to sale on the stands. Between these rows, the merchants pass along, and make their purchases. At the end of an hour, a bell rings, and the market closes. Such goods as are purchased, are carried to the merchants' houses; the goods that are unsold, remain in the hall till they find a purchaser. Lately, however, the system is in some degree changed; some merchants give samples
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ENGLAND.
Statistics,

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and the goods are brought directly
to him, without being exhibited in the hall. The goods
are bought in the halls in their undressed state, and
undergo in the working room, or shop of the merchant
who purchases them, various processes, till, being complete, they are sent either to the home or foreign marto the manufacturer,

ket.

Sometimes, however, goods are dressed at a

who

ted rate by dressers,

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take tliem in for that pur-

pose.
Prof!Te«s of

madunery.

Although

it is totally foreign to the object of this
touch upon the nature of the processes
through which this or any other manufacture goes, yet
we may be allowed to state generally, that almost all
the machinery now used in the woollen manufocture
was borrowed from the cotton manufacture. The spinning jennies were first introduced next, the slubbingThe spring
mill ; and thirdly, the carding machme.
shuttle was first used in Yorkshire, and afterwards in-

article to

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151

other hand, the gig-mill, which is employed for rai- ^""Y"^'
sing the nap after fulling, was long in use in Gloucestershire, before

it

was employed in Yorkshire, or

even in Somersetshire, or Wiltshire.
By the stamping acts, 2d Geo. II. and 5th and 6th
Geo. III. returns are ordered to be made every Easter
to the justices at Pontefract Sessions, of the quantity of
cloth made in the preceding year in the West Riding,
accounts being kept at the fulling-mills by officers for

This law, however, does not extend to
that purpose.
kerseymeres, and several other kinds of cloth.
In the following Table is given the returns from the
Pontefract Quarter Sessions, down to the present year,
from which not only the great increase in the quantity of goods, which come under the act, may be noticed, but also the greater proportional increase in the
quantity of broad cloths.

IV.
An Account of Ihe nnmher nf Broad Cloths MiUe<l at the several Fulling Mills :ii the West Riding qf
the County of York, from the ^ith June \Ti5, {the commencemetit of the act,) to the lltk March 1726", and
thence aniiuallu, dislin>uiihing each year } and of the Narr<n Cloths, from the Isl of August \1S1 (the commencement 'f tht act,) to the'lOth Januaty 17^8, andthenc^ annualJy, distinguishing each year ; likewise the num-

Table

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of Yards made

C'lch

year, from Easier Sessions 1768.
Narrow

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Yeara.

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1730

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1758
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1760
1761

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1763
1764
1765
1766
1767

1768

Varrows.

Years.

Pieces.

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1769
1770

25.22.'?^

1771

29,643

1772
1773
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1798
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35,563
35,5484
34,620
31.123
31,7444
33,899
42,256
42,404
43.0864
41,441
46,364
44.9.^4

45,1784
54,6274
50 453
56,637
62,480
60,765
60,7054
60,4474
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57,125
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55.7774
60,396
51 8774

49 6y4
48 944
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48,621
48,0381
54.916
54,660
72.5754
102,428
90,036

14495
58,848
.58,620

61,196
62.804
63.545
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63.423
68 775
68.374

68 080
68,889
78,115
74,0'i2

72 442
71-6<8
72.394
76.295
79,318
77.05)7

66.396
65,513
69.573
75.468
72.946
72.096
79,458
77,419
78,893
78,819
74,480

93,075
92,782
112,370
120,215
87,201
95,878
99,733
107,750
132,506
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3,153,891
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102,018
112,470
131,092
138,023
157,275

3,099,127
4,458,405
4,563,376
4,094,335

1.58.792

4.934,975
4,850,832
4,24 K322
4,716,460
5,151,677
5.815,079
6,760,728

1.55,748

139,406
154.134
172,588
187,569

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190,3,52

6,0549 16

190,988
250,993

6,067,208
7.759,907
7.830,536

246 775
229,292
224 159
272,755
285.851

Pieces

Yards.

87,762
85 376
89,920
95,539
89,8744
88,323
96 791'
99,586
95,7H6
101,629
93,143
87,309
98,721
96,743
108,641
115,500
116,036
123,025
128,740
132,143

2 144,019

Yards.

7 235

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14.5,495

140,407
134,373
190,468
150,666

2 255,625
2 2.',5,625
2,377,5174
2,306.235
2,133,583
2 441,007
2,488,1404
2,601,583
2 746,712
2,659,659
2,571, .324
2 671,337
2,598,751

3,292,002
3,356,648
3,409 278
3,536,889
4,058,157
4,208.303
4.409.673
4,582,122
4.797,594
5,531,698

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8 806,688
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151,911
158,252
141,809
136,863
142,863

269,892
318,431
369,890

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By the same stamping acts, three sets of officers were appointed to superintend the woollen manufacture, both in Yorkshire and in the west of England; but in the west they perform their duty in a very negligent manner, and in Yorkshire they are by no means very strict or careful. These officers are, 1st, the searchers, who measure the cloth at the fulling-mill, after it is full, stamp it, and put their seal on it, with the length and breadth, which are entered in a book. After this, the clothier may take it away. The second set of officers, are the inspectors, who go among the dressers, in order to see that they do not overstretch the cloth, and restamp them, if materially short or narrow. They also inspect the tenters, and observe that improper cards are not used in dressing the cloths. The last set of officers are the supervisors, who superintend the others. In purchasing cloth, however, the merchant does not consider himself bound to take the pieces at the length which the searcher has stamped upon them.

Norwich was the first seat of the worsted manufacture in England, or rather perhaps Worsted, a small town in the county of Norfolk, from which the manufacture took its name. About the end of the 14th and beginning of the 15th century, this species of manufacture extended itself, not only over the county of Norfolk, but even through Suffolk and Cambridgeshire; and, in process of time, sent its colonies into Essex, the midland and southern counties, and even into Yorkshire. In the time of Henry VIII., the sale of stuffs made in Norwich only amounted to 100,000 annually, besides stockings, which were computed at 60,000 more. During the two succeeding reigns, new articles of manufacture were introduced; and, in 1575, the Dutch, who fled hither from the persecutions of the Duke of Alva, introduced the making of broadsaxes, a manufacture for which this city has been long famous. At this period, however, and for a considerable time afterwards, its trade did not depend so much upon foreign demand as it does now. As long as Sir Robert Walpole continued in power, he encouraged its manufactures of crape, then a staple article, by using his influence for orders to be given, that the public mournings should always be in Norwich crape. The most fatal blow to the home trade of this city was given by the prevalence of cotton manufactures, which began to be sold cheap, after the invention of Sir Robert Arkwright. It then became absolutely necessary for the Norwich manufacturers to seek a market abroad; and this they succeeded in obtaining. There was scarcely a country in Europe, in which their goods were not to be seen, and the demand for them increased so much, and so rapidly, that it became necessary to increase the imports of raw yarn from Ireland. Before, however, the commencement of the first Frenchrevolutionary war, the manufactures of Norwich began to show symptoms of decline, and the war completed its ruin. It has since revived a little, but probably will never regain its former prosperity. While the trade was tolerable, it was estimated that about 50,000 tods of wool were combed and spun in the county of Norfolk, which employed about 500 combers, and furnished spinning work for most of the poor women and children in the county. During its flourishing state, the returns of the manufacture were estimated to be about L1,200,000 per annum; and even in 1805, when it was deprived of many of its foreign markets, the returns were nearly L800,000. Of this sum it was calculated that the price of labour took off L685,000, while the value of the raw material, dying stuff, oil, soap, and coals, was only L115,000; thus shewing its great importance. It furnished employment for about 50 distinct occupations. The staple articles of manufacture in Norwich may be said to be its fine camblets, of which the East India Company take off annually a considerable quantity, and its worsted damasks, shawls, &c.

Before proceeding to the consideration of the woollen manufacture of North Wales, it may be proper briefly to notice the districts, or places in England, where other species of goods made from wool, than those already noticed, are manufactured. It would be tedious, however, even to name all the kinds of these goods, or the various places in which they are made; we must, therefore, content ourselves with noticing the most considerable. In Devonshire, and the adjoining part of Cornwall, as well as in some parts of Somersetshire, a variety of woolen goods, little consumed in England, are made, such as druggets, long-ells, &c. These are sold as they come from the loom to the merchants of Exeter, where they are milled, dyed, and finished, and afterwards exported. The East India Company take off a large proportion of the long-ells: while this manufacture was in a flourishing state, the average annual value exported to all parts was valued at L600,000. In other parts of Devonshire, there are also branches of the woolen manufacture; of which the manufacture of plush, at Modbury, deserves notice, on account of the ingenious construction of the machines used for this purpose.

A large manufacture of baize was formerly carried on in the towns and neighbourhood of Colchester, Bocking, Braintree, and Coggeshall, in the county of Essex. This article was exported to Spain, Portugal, and Italy; but the manufacture has greatly declined here, having passed to other places, especially to Rockdale, in Lancashire, on the borders of Yorkshire. This, indeed, is one of the most flourishing places in the kingdom, for the manufacture of baize, serges, flannels, &c. The population of the district, in which this manufacture is carried on, is about 36,000; and it is calculated that one half are employed in it. Baize and flannels are also manufactured at Bury, in Lancashire, and the former article, with coarse cloth and blankets, at Chichester in Sussex. Salisbury is noted for its flannels. Blankets are made at Leeds, Witney, Dulverton, &c. With respect to Witney, however, it may be observed, that since the introduction of machinery, the chief part of the blankets (though they still retain the name) are made in Glamorganshire, and sent to Witney. Carpets are manufactured at Kidderminster, Wilton, Cirencester, Worcester, Axminster, &c. These made at the last place are deemed equal to any imported from Turkey or Persia.

At Kendal, Ambleside, and Keswick, there are made considerable quantities of coarse woolens, druggets, &c. At Andover, Basingstoke, and Alton, in Hampshire, the latter article, and shawls, serges, and a variety of worsted articles. At Banbury and Coventry, worsted shags. At Burford, rugs. Fleecy hosiery at Godalming, in Surrey. It has already been mentioned, that the Norwich manufacture extended itself into Suffolk; but the articles now made there rather differ from those made in that city, consisting of light stuff, butting, crape, &c. The manufacture of these articles is carried on at Sudbury, Bury St Edmund's, Needham Market, and Lavenham. In this county,
The woollen manufactures of North Wales, as has been already mentioned, are carried on principally in Montgomeryshire, Merionethshire, and Denbighshire. They consist of webs, flannels, stockings, socks, wigs, and gloves. As the stockings made in Wales are all worsted, we shall consider them here apart from the stocking manufacture of England. The webs manufactured in North Wales are distinguished into two sorts; strong cloth, or high country cloth; and semi-cloth, or low country cloth. The first kind is made in Merionethshire, principally on the domestic system, but in some parts there are factories. Almost every little farmer makes webs, and few cottages are without a loom. In some cases, the manufacturing farmers employ wool of their own growth; but it is principally bought from the wool staplers and skinners: all kinds are sold indiscriminately. The quality of the manufactured article is of various degrees. There is a market for strong cloth at Shrewsbury; but it is customary for the drapers of that town to go up into the country, (as they term it,) and buy goods, wherever they can get them. It is likewise a custom with the principal drapers to keep servants the greater part of the year in the vicinity of the manufactures, who get acquainted with the persons who make cloth, assist the poor ones probably with money to purchase wool, and superintend the making and dressing of the goods. Most of the strong cloth is exported from London or Liverpool, to Holland, Germany, and America — a very considerable quantity being used at home for workmen's jackets, ironing cloths, blankets, &c.

Strong cloth.

The small cloth is manufactured in Denbighshire, entirely in a large tract of country, which includes Llangollen and Corwen. The factory system has not yet been applied to this article. The raw material is procured from the neighbourhood of Oswestry, and is sorted into two kinds. The finer part is manufactured into a sort of flannel, called Oswestry flannel; while the coarser part is made into small cloth. Most of this is sent abroad; and the purposes to which it is there applied are various. The clothing of the slaves in the West Indies and South America, creates a large demand. Stockings are made to be made of it in Germany, and other parts of the Continent.

Flannels.

Flannels form the most important and valuable of the manufactures of Wales: they are principally made in Montgomeryshire; but not entirely so, being made in various places within a circle of about 20 miles round Welshpool. The manufacture of flannels is chiefly of the domestic kind, there being very few factories in which it is carried on. In Shropshire, however, into which this native manufacture of Wales has spread itself, machinery in general is substituted for manual labour. The market for flannels is Welshpool: formerly, each manufacturer used to bring his own goods; but now a set of middle-men go about the country, and buy all the flannel they can lay their hands upon. At the Pool-market, nothing is bought on credit, every piece being paid for as soon as measured: it is the same with the rest of the woollen manufactures of the principality. There is no accurate calculation of the number of yards manufactured, nor indeed can they be conjectured with any probability. Mr Pennant, in the year 1781, says, that there were annually brought into Salop, 700,000 yards of webs; and to Welshpool, between 700,000 and 800,000 yards of flannel; but it is not known on what data he grounds his calculation. Stockings, socks, wigs, and gloves, are made principally in the town and neighbourhood of Bala, where they are sold. It is said, that on a market-day, from L.200 to L.500 worth of stockings alone are sold.

Having thus given a pretty detailed account of the state of the various branches of the woollen manufacture of England and Wales, introduced by some historical sketches of its state formerly, we shall conclude this branch of our subject with an attempt to ascertain, as nearly as we can, the following points; viz. the value of the manufactured article; the value of the raw produce from which it is manufactured; the amount of the profits of the master-manufacturers, including interest for the capital, and an allowance for machinery, &c.; the amount of the sum paid in wages; and the number of people employed in this branch of manufacture. For these calculations, the data we take are the amount of the value of the woollen goods exported, and the proportion which their value bears to the value of the woolen goods kept for home consumption. We have already seen, that the manufacturers examined before the House of Commons in the year 1800, estimated the total value of the woollen manufactured goods, at the sum of L.19,800,000; but, as we observed, they erred in supposing that the stock of wool in the kingdom was 600,000 packs, whereas, in fact, it does not reach 400,000. They probably were mistaken, also, in the price they put upon the wool at that time. Making deductions on these accounts, and, on the other hand, allowing for the Spanish wool employed, it is probable that the total value of the woolen goods, at that time, will be, as we have already stated, about L.17,250,000. The official value of woollen goods exported in 1799, was L.6,435,423; and, in the year 1800, L.6,918,175: the real value, therefore, must have been above L.9,000,000; but let us take it at L.5,000,000; and the value of the whole manufacture at L.18,000,000: on this supposition, which is sufficiently near the fact for our purpose, the real value of the woolen goods exported, will be about one half the value of the whole goods manufactured in this kingdom. Circumstances, however, did occur, which necessarily varied this proportion; since, in consequence of our disputes with America, and the state of the European continent, the official value of woollen goods exported in 1808, was only L.4,883,580; in 1809, L.5,416,151; in 1810, L.5,773,214; in 1811, L.5,376,445; and, in 1812, L.5,084,991. But we must not conclude, because the value of the exports was diminished, that therefore the total value of the goods manufactured was lessened in the same proportion; for, however it might be with respect to other manufactures, or with respect to some branches of the woollen trade, the demand for woolen goods for the army was increased, at the time when the foreign demand was diminished. We may therefore safely suppose the total value of the woolen goods manufactured in England and Wales, to be now what we have supposed it to be in the year 1800, viz. about L.18,000,000; of this we must deduct a third, or L.6,000,000, for the value of the raw produce, which will leave the sum of L.12,000,000 for produce the master manufacturer and his workmen. On the average, the following points; viz. the value of the manufactured article, the value of the raw produce, and the wages paid to the workmen.
ENGLAND.

The next branch of the manufactures of England that we shall notice, is that of cotton. This exhibits a more surprising instance of rapid and extensive progress, than can perhaps be shown in any country, with regard to any species of manufacture. There is no evidence that any article was made of cotton in this country prior to the middle of the 17th century. In the year 1641, cotton was imported from Cyprus and Smyrna, and made into fustians at Bolton, in Lancashire. As this species of goods passed under the name of Augsburg and Milan fustians, it is not improbable that the mode of manufacturing them was introduced from Germany or Italy. About 20 years afterwards, cotton was imported from our North American colonies; and, as a law was passed in the year 1660, prohibiting it from being landed anywhere but in the English dominions, it is probable that its value and utility, as an article of manufacture, were beginning to be understood and experienced. The cotton trade, however, must have been for several years afterwards conducted on a very narrow scale; since, on an average of five years, ending 1705, the total quantity of cotton-wool imported into England was only 1,170,881 pounds. In the year 1765, the cotton-trade could scarcely be said to be known here; and a considerable quantity of the cotton-wool which we procured from our colonies, we exported to Holland. Two years afterwards, however, an invention took place, which, though it is rude and imperfect, compared with the machinery at present used in the manufacture of cotton, was of the greatest importance in establishing and extending the trade: we allude to the invention of the jenny. Some years previous to this, however, the preparation of the cotton for spinning had been facilitated by the invention of a rude carding machine. The jennies, or spinning machines, were first used by the country people in Lancashire, on a very confined scale, few of them having more than 12 spindles. The awkward posture required to spin on them, was discouraging to grown up people, who saw, with surprise, children from nine to 12 years of age, manage them with dexterity. The consequences of this invention were beneficial, not only to the master manufacturers, but also to the labouring classes of the community; for the younger branches of their families, who previously had been without regular and full employment, now gained considerable wages, while the weavers, by employing their own children at the spinning machines, were no longer at the mercy of the spinners. But, notwithstanding the manifest utility of this invention, and the benefits it produced to the weavers, some risings of the people took place, and the jennies were destroyed by the uninformed populace. By degrees, their fears and jealousy of this invention diminished; and a general acquiescence in their use, to a certain number of spindles, was brought about, by the prudent and sensible conduct and admonition of some respectable people in Lancashire. The labouring classes were not long in reaping such general and undoubted benefits from them, that the spindles were soon multiplied to three or four times the original number; and the demand for twist for warps increasing in proportion as the quantity of weft supplied by the spinning jennies became more abundant, new machines were invented, for the purpose of manufacturing twist, and a new impetus was given to the cotton trade.

These machines were the invention of Sir Richard Arkwright: by means of them, thousands of spindles per minute are put in motion by a water-wheel, and managed mostly by children, without confusion; and with less waste of cotton than by the former methods. Soon after the invention of Sir Richard Arkwright's machines, the people of Lancashire were incited against them, and some of them were demolished before protection could be obtained: this arose from their producing such excellent twist for warps, that they soon outrivalled the warps made on the larger jennies, which had yielded good profit to the owners. But experience soon convinced the people, of what, indeed, a little reflection might have taught them, that if more warps were made, there would be a greater demand for weft from their jennies, and a better price for it. Upon these machines, twist could be made of any fineness proper for warps, but it was not so proper for weft. On the introduction of fine calicoes and muslins, which took place in the year 1781, another machine was invented, called a mule, being a mixed machine between the jennies and the machines for twisting, and adapted to spin twist as fine as could be desired.

As this invention, by creating the necessity and advantage of large cotton manufactories, and by destroying what may be called the domestic system of the cotton trade (at least so far as respects the spinning of cotton), has altered not only the state of the trade, but, in our opinion, the moral character and habits of the manufacturing labourers engaged in it, it may not be
unimportant or uninteresting, to take a retrospective view of what were their condition and habits previous to this invention.

From the time that the original system in the fustian branch, of buying pieces in the grey from the weaver, was changed, by delivering them out work, the custom of giving them out woof in the cops, which obtained for a while, grew into disuse, as there was no detecting the knavery of spinners till a piece came to be woven; so that the practice was altered, and wool given with warps, the weaver answering for the spinning. The weavers, in a scarcity of spinning, have sometimes been paid less for the woof than they gave the spinner, but durst not complain, much less abate the spinner, lest their looms should be unremunerated; but when spinning jennies were introduced, and children could work upon them, the case was reversed. At this period of the cotton manufacture, the cottage of the weaver presented an interesting and amiable picture: while he was engaged at his loom, his children were employed in spinning the woof; the feelings and habits of domestic life were entire; and that link of affection between a father and his children, which secures each very frequently from vice and misery, and which is closely and intimately connected with the best interests of society, was sound and unbroken. Lower wages were obtained than are now got under the factory system, but as methods, regularity, economy, and sobriety, prevailed, what they earned procured them more of the necessaries and comforts of life, than they can now obtain with their increased wages. At that period, Lancashire, which has always displayed, in a conspicuous and peculiar manner, the wealth and the vices of the cotton trade, was not disgraced and degraded by those instances and scenes of vice and misery which now spread over its surface. The relationships of parents and children were not then merely a name; home was not then deserted for the ale-house, or for places of still greater debauchery and vice; health was not then so lavishly sacrificed to the cupidity of the master manufacturer, or so much despised and neglected by the manufacturing labourer, in the pursuit and indulgence of his passions. In short, the manufacturing classes were then respectable, comfortable, healthy, and virtuous, because they spent the greatest part of their time in their own families, and not in crowded manufactories, amidst the contagion of ignorance, vice, and misery. But we forget that our subject and inquiries are statistical, not moral; and that our object is to give some historical notices of the state of the cotton trade, as a source of national and individual wealth, at different periods.

For several years after the commencement of the present reign, the whole value of the cotton manufactures of this kingdom, (including Scotland as well as England,) was estimated to be less than L. 300,000; and in the spinning of cotton yarn, for this amount of cotton goods, not above 50,000 spindles were employed. In the year 1781, when, as we have already noticed, muslins were first made in this kingdom, only 5,101,929 pounds of cotton wool were imported. In 1782, in consequence of the increased demand for muslins, the quantity of cotton wool was more than doubled, and the amount of cotton goods was estimated at nearly L. 4,000,000. During the years 1783 and 1784, there was no increase in the importation of cotton yarn, and consequently no increase in the value of cotton goods. In the year 1784, the patent which Sir Richard Arkwright had obtained, for his invention of water-mills, expired, and they were immediately erected in all parts of the kingdom; and although the mode of spinning wool by machinery was yet scarcely known, yet the spinning of it by the hand engines nearly kept proportion with the increased supply of warp. This year, the importation of cotton yarn amounted to 11,280,238 pounds, and the estimated value of the cotton manufactures was L. 3,950,000. In the following year, a great increase was visible; the quantity of imported raw material having been L. 17,992,888, while the value of the goods had risen to the sum of L. 6,000,000. In 1786, the quantity of cotton wool imported, amounted to 19,151,877 pounds, which was manufactured into goods of the value of L. 6,500,000. And in the year 1787, the quantity of cotton wool was 22,176,887 pounds, which produced goods of the value of L. 7,500,000.

A writer, who investigated the subject of the cotton manufactures at this time, estimates the supply and expenditure of cotton in the year 1787, in the following proportions:

<table>
<thead>
<tr>
<th>Imported from</th>
<th>Pounds</th>
<th>Worked up in</th>
<th>Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>British West Indies</td>
<td>6,600,000</td>
<td>Candle-wicks</td>
<td>1,500,000</td>
</tr>
<tr>
<td>French and Spanish colonies</td>
<td>6,000,000</td>
<td>Hosiery</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Dutch ditto</td>
<td>1,700,000</td>
<td>Cotton goods, mixed with silk or linen</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Portuguese ditto</td>
<td>2,500,000</td>
<td>Fustians</td>
<td>6,000,000</td>
</tr>
<tr>
<td>East India ditto</td>
<td>100,000</td>
<td>Calicoes and muslins</td>
<td>11,600,000</td>
</tr>
<tr>
<td>Smyrna and Turkey</td>
<td>5,700,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22,600,000</strong></td>
<td></td>
<td><strong>22,600,000</strong></td>
</tr>
</tbody>
</table>

This estimate, however, is not correct, with respect to the quantity imported from the British West India colonies; since it appears, from the report of the committee of the privy council on the slave trade, that the cotton imported from Jamaica, Grenada, and Barbadoes, in the year 1783, exceeded the quantity here stated as imported from all the British West India Islands. In order to reconcile this with the estimate of the quantity of cotton, which is stated above, to be used in the manufactures of this kingdom, in the year 1787, viz. 22,176,887 pounds, it must be observed, that there was always a certain proportion re-exported; so that, probably, the quantity actually retained for home consumption was very near what it is here said to have been. It may be proper to point out the view of the state of the cotton manufacture at this period, which is afforded by the comparative quantities of the cotton wool employed in its different branches. Fustians, as we have seen, were the oldest cotton manufactures in the kingdom, whereas muslins and calicos had only been introduced six years before, viz. in the year 1781; and yet, the quantity of cotton wool employed in the latter, in the year 1787, was, according to this statement, very nearly double the quantity employed in the manufacture of fustians. The same author gives an estimate of the number of water-mills, or machines for spinning
twist cotton yarn for warps, both in England and Scotland. We shall lay before our readers his estimate for both countries, in order that they may be enabled to take a comparative view of the state of the cotton trade in them both.

In Lancashire . . . . 41 Lanarkshire . . . . 4
Derbyshire . . . . 22 Renfrewshire . . . . 3
Nottinghamshire . . . . 17 Perthshire . . . . 2
Yorkshire . . . . 11 Edinburghshire . . . . 2
Cheshire . . . . 8 The rest of Scotland . . . . 6
Staffordshire . . . . 7
Westmoreland . . . . 5 In all Scotland . . . . 19
Flintshire . . . . 3 In the Isle of Man . . . . 1
Pembrokeshire . . . . 1
Berkshire . . . . 2
The rest of England . . . . 6

In all England . . . . 119
In Wales . . . . 4

In England and Wales 123

The whole number being 143, the cost of which was estimated at L 715,000. There were at the same time 550 mule jennies, or machines of 90 spindles each, and 20,700 hand jennies of 80 spindles each, for spinning yarn for the slube or woof, the cost of which, and of the auxiliary machinery, together with that of the buildings, is stated to have been at least L 285,000, making the total expenditure on the machinery and buildings L 1,000,000. It was, moreover, calculated, that these establishments, when in full employment, produced as much cotton wool, as could be spun by a million of persons, upon single wheels. At this period, it was calculated also, that there were employed 26,000 men, 31,000 women, 58,000 children, in all 110,000 in the operations of spinning; and 153,000 men, 59,000 women, and 48,000 children, in all 250,000 in the subsequent stages of the manufacture; there being, in all, 159,000 men, 90,000 women, and 101,000 children, and a total of 350,000 persons employed in this manufacture; nearly one-third of them in the calico and muslin branches. In these most important branches, at this time, the raw material was advanced in value from ten to fifty fold.

From the data which these statements afford, we may be able to ascertain several particulars respecting the state of the cotton manufacture in England at this time, separately from the state of it in the kingdom at large; taking it for granted that the capital and number of people employed in England, bear the same proportion to the total capital, and number of people employed in the whole kingdom, that the number of water mills in the former did to the number in the latter. Now, as the number of water mills in Great Britain, was 143, and in England 123, we may consider the proportion in the latter as six-sevenths of the whole, which will give us, as the cost of the water mills in England, about the sum of L 600,000, and as the cost of the machines for spinning woof, and the necessary buildings, the further sum of at least L 240,000, making the total expenditure in England to be about L 840,000, the number of people employed in spinning the cotton wool about 35,000, and the number of people engaged in the subsequent stages of the manufacture to be about 405,000, in all about 500,000 people employed in the cotton manufacture in England. About this period, several very large cotton-works were established in different parts of England. The most extensive and considerable of which were those of Sir Robert Peel, at Bury, in Lancashire. By the report of the committee of the House of Commons, in 1785, on the subject of the commercial intercourse with Ireland, it appears, that this gentleman, at this period, employed 6900 people, and several thousands were employed by Mr Smith, and numbers, proportionally great, by other manufacturers of cotton. From the time of the invention of the mule, till the breaking out of the first French revolutionary war, the cotton trade of England flourished in a most astonishing manner; fortunes were made, especially in Lancashire, where it was carried on to the greatest extent, and with the greatest spirit and enterprise, with almost unparalleled rapidity. The improvements in the steam engine seconded the improvements in the machinery for spinning cotton, while improvements equally great and important were made in the mode of bleaching and dyeing the goods. Indeed, it may well be doubted, whether it could have been possible to have bleached, by the old process, all the cotton goods which were now made; so that the discovery which chemistry made in this art, came opportune

The breaking out of the war in 1793, gave a great effect to the shock to this trade; at first it was very severely felt; but after several of the most intelligent and well-informed of those who were engaged in it, having more leisure, by the decreased demand for their goods, than they formerly had, applied themselves to the further improvement of the machinery used in the spinning of cotton. Attempts were also made to work a number of looms together by machinery; and a factory was actually erected near Manchester to weave piece goods in this manner; but it was burnt down before any judgment could be formed how it could have succeeded. We shall afterwards see that the cotton manufacturers attained their object in a considerable degree, by the construction of what are called power looms.

In the year 1795, Dr Aikin published his History of Manchester, from which we have gathered the following miscellaneous information, respecting the state of the cotton district of England, at that period. According to him, the increase of value acquired by the raw material, in the labour expended upon it, in manufacturing, was generally from 1000 to 5000 per cent. At Ashton-under-Lyne, a considerable quantity of twist and warps was made, for the heavy goods that were manufactured in Manchester. At Middleton, the cotton trade was carried on in all its different processes; a large twist manufactory had been established, and very considerable printing and bleaching works: in this place, as well as in many other parts of Lancashire, the cotton manufacture had supplanted the long-established manufactures, the weaves of muslin and needle having taken place of the weaving of silk. Even at Rochdale, which we have already noticed as distinguished at present for its manufacture of flannels, and other woollen goods, the cotton manufacture seems to have gained a footing when Dr Aikin wrote; but though it has spread beyond this place into Yorkshire, it does not seem to have flourished much or extensively here. In 1796, the muslin trade was in a flourishing condition at Bolton; but, in consequence of the want of sufficiently powerful streams, there were but few spinning factories in this town; or its neighbourhood: there were, however, many crofts for bleaching. We have already noticed that Bolton was the original seat of the cotton manufacture; flaxmills having been made there about the middle of the 17th century; from Bolton the cot-
ton trade spread to almost all the places in Lancashire, in which it is at present carried on; among the rest, it spread to Bury, where it was in 1796, and is yet carried on, in conjunction with the manufacture of flannel, &c. The works of Sir Robert Peel, at this place, have been already noticed; they embraced nearly all the stages and processes of the cotton manufacture, spinning, weaving, bleaching, and printing. The first species of cotton goods manufactured at Blackburn were what were denominated Blackburn greys; these were plains of linen, warp shot with cotton. In 1795, this town had gone very extensively into the making of calicoes, and the fields in its vicinity were whitened with the materials lying to bleach. Haslingden has already been noticed, under the head of the woollen manufactures, as being a place in which woollen yarn is made: in 1795, twist for warps was spun in several of the factories in its neighbourhood, the cotton trade having been there lately introduced. We may here observe, that wherever the cotton trade gained a footing, (with very few and inconsiderable exceptions,) it preserved and extended itself; most certainly is the case in nearly all the places in which, or in the vicinity of which, the manufacture of woollens is carried on, as in those parts of the West Riding of Yorkshire, bordering on Lancashire. One of the most obvious and powerful causes of this is, that the workmen can with little difficulty turn themselves to the woollen trade, if the cotton should suffer a partial or temporary depression. Our remarks respecting the prevalence of the cotton over the woollen manufacture, is further confirmed by what had taken place about this period at Colne in Lancashire, where the manufacture of calicoes and dimities had, in a great measure, superseded the original and long established trade of making woollen and worsted goods.

But Dr Akin's account of the places near Manchester, is principally interesting and important in relation to our subject, from the account which it gives of Preston; we shall afterwards have occasion to notice this town as one of the most flourishing seats of the cotton manufacture: but it was only a short time before 1795 that it had gained a footing here; probably the general disposition and habits of its inhabitants, (for it was long known under the name of proud Preston,) presented a more formidable barrier to the introduction of the cotton trade, than would have been offered by any long-established manufacture. There had been here, however, a large mart for the sale of Lancashire linens; a species of manufacture which we may remark the cotton trade has nearly rooted out of Lancashire, or at least out of those parts where it has gained a footing.

In 1795, Chorley was already known for its cotton factories and its bleaching and printing grounds; and this flourishing and flourishing trade had established itself at Wigan, notwithstanding the opposition of its original and celebrated manufacture of checks. But no place in the vicinity of Manchester perhaps exhibited, though on a small scale, such a picture of the extension of this trade, as a small village in the parish of Leigh. In 1780, there were only two farm houses, and eight or nine cottages; in the year 1795, there were 182 houses, and 976 inhabitants, who employed 925 looms in the cotton manufactures, as marseilles quiltings, dimities, corduroys, &c. and this rapid increase had by no means reached its utmost limits. At Warrington, Dr Akin remarks, there had been a curious alternate reverse in the state of the staple manufacture of the place,—sail-cloth, and the manufacture of cotton. After the termination of the American war, the demand for the former necessarily ceased in a great degree, several of the manufacturers introduced the cotton branches; and as the cotton goods made were principally of the coarse kind, the sail-cloth weavers found no difficulty in turning themselves to the new manufacture; but when the French war broke out, the demand for sail-cloth again becoming extensive and pressing, the original trade regained its footing.

The cotton manufacture, which, as we have seen, had its original seat at Bolton, and thence extended itself not only some way into the north of Lancashire, but also to its southern extremity, passed easily from the last into Cheshire. The place where it seems first to have fixed itself, was Stockport; and it is not improbable that the circumstance of there being here mills for winding and throwing silk, which were unemploy-ed, by a decline of this trade, contributed to establish the cotton manufacture at Stockport; for there mills were applied to cotton spinning. Perhaps no town in the whole cotton district of England exhibits more of the active and enterprising spirit of trade than Stockport: at first the inhabitants engaged in the spinning of reeled wool, then in weaving checks, and lastly in fustians; and scarcely had the invention of mules produced a thread sufficiently fine and soft, than they began the muslin trade, which in 1795 was as flourishing as the circumstances of the times would admit of;—the present state of the latter trade in this town, we shall afterwards notice. In 1795, besides a large number of cotton-spinning shops, there were 23 large cotton factories, four of which were worked by steam engines. At this period the cotton trade had been introduced into several other places in Cheshire, adjoining to Lancashire, among the rest into Macclesfield, Mowbray, where there were 12 large machines worked by water, besides a great number of smaller ones turned by horses,—and Duckinhill. In this last place, the pernicious effects of the cotton factories on the health and longevity of the inhabitants, were particularly striking; while the trade had afforded employment to all ages, it had debilitated the constitution, and retarded the growth of many, and made an alarming increase in the mortality. This effect was principally attributed to the custom of making the children in the mills work night and day, one set getting out of bed, when another went into the same; thus never allowing the rooms to be well ventilated. Before we conclude this sketch of the state of the cotton trade in Cheshire in 1795, we shall mention one decided and striking proof of its rapid advancement; in 1788, as we have already seen, there were only eight water-mills in the whole county; in 1795, in Stockport alone, there were 23 large cotton factories, besides a great number of spinning shops.

Derbyshire also, at the latter period, had entered pretty considerably into the cotton trade, not only in and near the county town, but also at Glossop, Chapel-le-Frith, Bakewell parish, (into part of which the manufacture of muslins had been introduced); Cromford, the residence of Sir Richard Arkwright, and the first place in this county in which he established his works; Chesterfield, where a cotton mill had then been very lately erected; and other places.

From these details, a pretty accurate view of the cotton trade in 1795 will be gathered; and when it is re-collected, that at this period mules had not been invented much more than 15 years, and water-mills not 28, and that prior to the invention of the latter there could not properly be said to be any such trade as the,
cotton trade in England, we shall be disposed to admit, that no country can exhibit a more striking instance of enterprising and successful industry.

One of the most obvious and accurate means of judging the progress of any manufacture, and of its comparative state at different periods, is by ascertaining the relative quantity of the raw materials used at those periods. We shall therefore lay before our readers an account of the quantity of cotton imported in Great Britain, on an annual medium of four periods, of five years each, commencing 5th January 1772; premising, that the quantity imported for the use of England may be estimated at six-sevenths of the whole. On an annual medium of five years, from 1772 to 1776, the quantity of cotton wool imported amounted only to 4,414,757 lbs.; during the next period, down to 1787, it had increased to upwards of 16,000,000 lbs.; in the next, down to 1792, the quantity was nearly 29,000,000; and in the last of the series of periods, including five years preceding the 5th of January 1799, on an annual medium it amounted to upwards of 26,000,000 lbs. In the year 1795, there were printed in England and Wales, of English calicoes and muslins, upwards of 24,000,000 yards; in the year 1800, upwards of 23,000,000 yards: the value of the former being about L 3,500,000, and of the latter about L 4,150,000; but as the quantity of white muslins and calicoes made in England and Wales, was probably much greater than that of the printed, they may be estimated at the value of L 3,000,000, even though their price, from not being printed, was not so high as the others. The annual exports of British cotton manufactures, from all the parts of the kingdom, on the average of three years, 1797, 1798, and 1799, was upwards of L 4,000,000. In the year 1801, the import of cotton-wool into Britain was 42,000,000 lbs. and the estimated value of the cotton manufacture L 15,000,000 sterling. In 1802, the importation of cotton-wool was not less than 54,000,000 lbs.; and the particulars of the trade were stated, on good authority, to be as follow:—"The raw material, when delivered on board the merchant ships, costs about L 4,000,000 sterling; upwards of 30,000 tons of shipping, and about 2000 steamers, are constantly employed in bringing cotton-wool to this country, and in exporting the goods manufactured from it. To work the wool into thread, requires a capital in building and machinery to the amount of L 19,255,000; and those buildings and machinery are chiefly composed of bricks, slates, glass, timber, lead, iron, copper, tin, and leather, from most of which, in one shape or other, a considerable duty is collected for the support of the state. This trade gives employment or support to upwards of 800,000 individuals; and the annual return of the manufacture is nearly as follows:—

**Table V. Cotton Imported.**

<table>
<thead>
<tr>
<th>Years</th>
<th>Europe</th>
<th>United States</th>
<th>British West Indies, and Colonies</th>
<th>Foreign Colonies on the Continent of America and West Indies</th>
<th>East Indies</th>
<th>Other Parts, including Prize</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1805</td>
<td>9,154,168</td>
<td>31,943,280</td>
<td>16,800,289</td>
<td>569,104</td>
<td>355,493</td>
<td>860,072</td>
<td>58,862,406</td>
</tr>
<tr>
<td>1806</td>
<td>7,555,597</td>
<td>28,000,681</td>
<td>18,879,442</td>
<td>609,254</td>
<td>2,640,798</td>
<td>480,841</td>
<td>58,176,283</td>
</tr>
<tr>
<td>1807</td>
<td>4,882,906</td>
<td>48,592,390</td>
<td>19,706,208</td>
<td>1,251,221</td>
<td>3,574,137</td>
<td>618,914</td>
<td>47,825,306</td>
</tr>
<tr>
<td>1808</td>
<td>2,872,980</td>
<td>12,522,861</td>
<td>16,035,935</td>
<td>5,800,856</td>
<td>5,151,496</td>
<td>878,866</td>
<td>45,605,982</td>
</tr>
<tr>
<td>1809</td>
<td>10,920,783</td>
<td>34,857,094</td>
<td>16,201,800</td>
<td>19,788,181</td>
<td>10,927,122</td>
<td>108,506</td>
<td>92,812,282</td>
</tr>
<tr>
<td>1810</td>
<td>16,725,708</td>
<td>55,194,616</td>
<td>17,889,184</td>
<td>22,137,976</td>
<td>23,149,976</td>
<td>1,478,291</td>
<td>136,570,103</td>
</tr>
</tbody>
</table>

| Total | L 4,725,000 | L 20,208,750 | L 51,100,000 | L 1,383,750 | L 9,000,000 |

Of which sum, at least L 13,000,000 sterling are paid in wages to the natives of Great Britain."

Though these particulars relate to the state of the cotton trade in Great Britain, yet we have quoted them, as exhibiting a striking picture of its extent and importance at this period, and of its rapid advance, which proceeded in England in at least an equal degree as it did in Scotland.

In the year 1787, it will be recollected, the number of water mills in the whole of Lancashire was 41; and at different periods, the number of mule spindles, worked both by machinery and hand, in Great Britain, was about 1,700,000. In the year 1804, there were in Manchester alone 93 spinning factories, and at least 1,500,000 spindles in the different factories in the town and neighbourhood. Supposing that 1000 spindles are a fair average for each horse power, and that the steam engines averaged a ten-horse power, these spindles would have required 150 such steam engines to work them; which, at the estimate of a ton of coal per day for each engine, must have consumed about 50,000 tons of coal annually.

In the year 1812, there was laid before the House of Commons an account of cotton-wool imported, containing the average of four periods, of five years each, beginning 1792, which we subjoin, although we have already, in some degree, anticipated the result of the importation during the first series of years.

Average of 5 years, from 1792 to 1796, 27,866,938 lbs. 1797 to 1801, 42,125,865 lbs. 1802 to 1806, 58,776,780 lbs. 1807 to 1811, 87,881,808 lbs.

In order that the increase in the value of cotton goods exported may be compared with the increase in the quantity of cotton-wool imported, we give the two following Tables:
These Tables also serve to show the countries from which we got our cotton-wool, and the countries to which we exported our manufactured goods and our cotton yarn; for, in consequence of the great improvement in the machinery for spinning cotton, there were not weavers enough in the kingdom to manufacture it; while, on the continent, the weavers, who had been accustomed to weave linen and silk, easily turning themselves to the weaving of cotton, the superfluity of our yarn found a ready market there.

We shall conclude this branch of our subject, with a sketch of the present state and condition of the cotton trade in England; an attempt to estimate its value, with respect to the same points which we endeavoured to establish in regard to the woollen trade; and a comparative view of the two trades, as they seem to affect the wealth, the morals, and the general condition of those engaged in them.

The cotton district of England has nearly the same extent and boundaries now that it had 20 years ago, though the manufacture, in some, or all of its branches, may have appeared since that time in distant and insulated parts of the kingdom. Manchester may still be considered as the centre of this district. To the north-west and west of this town it is most widely diffused, having, since the period before alluded to, approached nearer the northern confines of the county. In Lancashire, Bolton, Blackburn, Wigan, and Preston, may be regarded as centres to the smaller divisions of this district, and as still engaged, for the most part, in those branches of the trade which they followed in the year 1795, and which have been already noticed. Stockport, to the south of Manchester, and Ashton to the east, are centres of the division of the districts which lie in these directions; when we pass them, we pass the limits of the regular cotton trade, though it makes its appearance as far to the south as Derby. Since 1795, it has gained a firmer and more extensive footing in the West Riding of Yorkshire, intermixing with the original and staple manufacture of that district. With respect to the places where the different kinds of goods are manufactured, it may be proper to give more minute information: Great quantities of checks are made at Carlisle, and in other parts of Cumberland; the lowest qualities of calicoes are made chiefly at Burnley and Colne in Lancashire, and at Bradford in Yorkshire; the best qualities at Blackburn and Stockport; the muslins are made at Bolton, Stockport, and the surrounding villages; the shirtings at Blackburn, Stockport, Manchester, &c.; the pillow handkerchiefs in the neighbourhood of Manchester; the quiltings and dimities in the neighbourhood of Bolton, as well as the bed-quilts and counterpanes; nankeens and cottonickings are chiefly made within seven miles of Manchester; velvets, thicksets, and cords, chiefly at Warrington; and velveteens principally at Oldham, and in very great quantity in those parts of Yorkshire which border on Lancashire; fustian cutting is almost entirely confined to the town of Manchester; bleaching and printing are chiefly carried on at Blackburn, Bury, &c. and the former at Bolton; calico-printing is also carried on extensively at Carlisle, and in the neighbourhood of London. Most of the mills for spinning cotton are in the neighbourhood of Manchester and Stockport.

The proportion of the population in the cotton district of England employed in that trade, is very great; some estimate it so high as five-sevenths. In Bolton it is supposed to be nearly one-half; in Stockport two-thirds. The proportion of men and women employed in weaving was formerly nearly equal; but, in consequence of the introduction of the power-looms, (to which we have before adverted, and which forms the most recent era in the history of the cotton trade of
this country,) though these looms as yet are but partially applied to weaving, the proportion of women employed in this branch of the cotton trade may be estimated to be greater than the men: the number of children is nearly equal to both men and women. The proportions employed in the preparation of the cotton and in spinning, are nearly four-fifths to one-fifth men: in this branch, also, the number of children is equal to both. The quantity of cotton manufactured in the cotton district, is estimated at about 81,000,000 lbs.

In the examination of witnesses before the House of Commons, in the year 1812, respecting rewarding Mr Crompton, who invented the mule, it was given in evidence, that the rate of increase of the cotton trade in Lancashire and the adjoining districts, within 30 years from that time, was as twenty to one; that four millions of spindles were employed according to Mr Crompton's invention; that two-thirds of the steam engines for spinning cotton turned mules; and that the value of the machinery, buildings, &c., on Mr Crompton's principle, was between L.3,000,000 and L.4,000,000; consequently the value of all the machinery of every kind employed in the cotton trade, must have been at least L.7,000,000.

As the official value of the cotton goods exported from Great Britain in 1809 and 1810 was upwards of L.19,000,000 each year, we cannot estimate the total value of the goods made in the cotton district in England, both for home consumption and exportation, at less than L.29,000,000; allowing the difference between the official and the real value, (which, however, cannot be great,) and the value of the goods retained for home consumption throughout the kingdom, to be equivalent to the value of the goods made in Scotland. But as it may be, said, that the quantity exported during these two years was much greater than the average export, and that the export of cotton manufactured goods in 1811 was only L.11,715,583, and of cotton yarn L.545,927, making a total of L.12,260,770; and of 1812, of the former L.15,672,826, and of the latter L.986,097, making a total of L.16,978,883; we shall suppose the steady average exportation to be only L.15,000,000, and allowing, as before, the difference between the official and the real value, and the value of what is retained for home consumption, to be equal to the value of what is made in Scotland, we shall take L.3,500,000 as the real value of the goods made in the cotton districts of England. As it is probable that 80,000,000 pounds of cotton wool is too high an estimate for the consumption of this district, we shall take it at 70,000,000; averaging the price at 2s. per pound; this will give L.7,000,000 for the total cost of it; leaving 8,000,000 for interest of capital, profit to the manufacturer, and wages of labour. As a very large proportion of women and children are employed in this trade, the average wages cannot be rated higher than L.15 per annum. The rate of profit to the manufacturer, including interest of capital, must be rated at L.20 per cent. since the expense and wear of machinery are very great. Now L.20 per cent. on L.8,000,000, is L.1,600,000, leaving L.6,400,000 for wages. This at L.15 per annum for each person employed, will give 426,666 as the number of people employed. And that this must be pretty nearly the number, will appear from the following considerations. The number of people in Liverpool, and in other parts of Lancashire where the cotton trade is not established, is probably considerably greater than the population of those places out of Lancashire, in which the trade is established; we may therefore take 600,000, which is about 200,000 less than the population of Lancashire, as the population of the cotton district of England; and supposing, as before stated, that five-sevenths of this population is employed in the trade, the whole number will be 428,570, which comes very near the number to which we brought it by the other mode of computation. The statement, then, with regard to the cotton manufacture of England, will stand as follows:

Total value of the manufactured article, L.15,000,000  
Value of the raw material, L.7,000,000  
Interest on capital, and manufacturers profit L.1,600,000  
Manufacturing wages 6,400,000  
Number of people employed, 427,000

In many respects, there is a striking and considerable contrast between the woollen and cotton manufactures, which, in every point of view, may be regarded as the most important manufactures of this country. In the first, the woollen manufacture in general, at least in the West Riding of Yorkshire, is carried on by men of comparatively small capital; whereas most of those engaged in the cotton manufacture are men of rather large capital. There can be no doubt that this point of contrast will soon vanish, both from the natural course of trade, and from the superior advantages which the factory system (so far as regards the grand object, the making of money) possesses over the domestic system. Factories are much more common now than they were formerly in the West Riding, and their number is increasing. In the second place, the cotton manufacture, as has just been incidentally observed, is distinguished from the woollen manufacture, by the mode of carrying on: the most important branch of it, the spinning, is entirely done in factories; and by the late invention of power looms for weaving, it is highly probable that, in the course of a few years, the next important branch, that of weaving, will also be carried on in factories. In the third place, it may be remarked, that in the cotton manufacture, the proportion of women and children, and more especially of the latter, to men, is much greater than in the woollen manufacture. In the fourth place, the cotton manufacture is not nearly so regular and steady a trade as the woollen manufacture. This seems to arise principally from two causes. In the woollen manufacture, the foreign demand and exportation is not more than equal to the home consumption; and the goods manufactured, being less articles of luxury, taste, and fancy, meet with a more regular and constant demand; neither the interruption of foreign trade, nor the vicissitudes of foreign fashion, therefore, can influence the demand so much as is the case frequently with the cotton manufacture. Moreover, in the case of the woollen manufacture, by far the greatest proportion of the raw material employed in it is of domestic growth; whereas in the case of the latter manufacture, the whole of the raw material comes from abroad; consequently the supply and price of it must vary very often, and very much. As, therefore, we depend on foreign countries for the raw material of our cotton manufacture, and on them also for taking off a much larger proportion of it than of our woollen goods, the trade in the latter must be more regular and steady than in the cotton trade.

But the most material and important contrast between the two species of manufactures, consists in the different condition of the people employed in them. Whoever has been in the woollen and cotton districts of England, must have been immediately struck with
this circumstance; and it is peculiarly striking, and almost forces itself upon a person who crosses the country from York to Manchester, and consequently passes immediately from the woollen district of the West Riding, to the cotton district of Lancashire. In the former, he observes much of the comfort and feelings of domestic life; the habits and manners of the manufacturing classes are sober, decent, and regular; they seem to have an interest and a pride in keeping up the respectability of their character, in setting a good example to their children, and in bringing them up in the paths of virtue. But, even before a traveller has time or opportunity to ascertain these facts, he is struck with the cleanliness and neatness of their dress and persons, with the healthiness of their looks, and with their steady and cheerful manners. Let him pass into the cotton district, and the case is most miserably reversed: the manufacturing classes are dirty, squalid, and unhealthy in their looks, having the appearance of debauchery and poverty strongly marked in their persons. Nor will these appearances, on enquiry, be found to be erroneous: the utmost ignorance and dissolution of manners prevail; there is none of that laudable feeling of independence, none of that prospective prudence, without which the manufacturing classes must always be sunk in poverty and vice. Such being the striking contrast, it is important to endeavour to ascertain its causes, and these by no means lie deep; they are sufficiently obvious. Before stating them, however, it may be proper to recall to our readers, that the principal points of contrast regard the health and morals of the manufacturing classes in the two districts: whatever causes will account for their difference in these respects, will also account for their difference in respect to comparative cleanliness, comfort, and pecuniary means. In the first place, then, the factory system being more prevalent in the cotton than in the woollen district, must be looked to as one of the primary and great causes: it is unnecessary to explain how this must operate in giving rise to disease and vice; but it may be remarked, that, in all probability, even if the factory system should become as prevalent in the woollen as it is in the cotton district, it will not produce effects equally prejudicial; and this, from the operation of the second cause of the contrast between the two trades, to which we shall now allude. - In the cotton trade, the number of children employed is very great; and it is easy to conceive how their health must be affected in a crowded factory, where they are obliged to work long before their strength is adequate to the task, and at a period of life when close and long confinement are extremely prejudicial. As they are sent to these factories before they receive any education, they can attain little while they are there, associate, while in them, with depraved characters, and at home meet with no encouragement or example to cleanliness or propriety of conduct; it is not to be wondered that they should almost universally exhibit instances of most disgusting filth, of most pitiable want of health, and of vice, which at any age would be shocking, and at their early age is peculiarly so. But there is still another cause to which we must advert, in order satisfactorily to account for and explain the contrast between the woollen and the cotton manufacturers. It has already been remarked, that in the woollen trade, the demand is more regular and steady than it is in the cotton trade; consequently, in the former, there are not so many, nor so great inequalities in the wages of the manufacturers. Besides, in the woollen trade, when the demand slackens, it is customary to dismiss as few hands as possible, but rather to keep them on at a lower rate of wages: whereas, in the cotton trade, when the demand diminishes in any considerable degree, multitudes of work people are thrown out of employment. Now, no person who is in the least acquainted with the habits and feelings of the labouring classes in England, need be told, that to them, high wages at one time, and low wages at another time, constitutes one of the greatest evils to which they can be exposed. They almost uniformly live up to the maximum rate of their wages; consequently, when they are not employed, or but partially employed, they have no means, or very inadequate means, of supporting themselves. Nor is this the only evil; while trade was brisk, they indulged in various things, which, of course, they cannot acquire when trade is bad: of course, in the latter state of things, they retain all the wants and habits which they acquired in the former state of things, and are no longer able to satisfy them. Thus, with high wages, they are extravagant, debauched, and thoughtless; and with low wages, they are starving. It must be obvious, that the more frequently those fluctuations in trade occur, which produce corresponding fluctuations of wages, the more confirmed and inveterate will all the consequences produced by these fluctuations become; and these consequences of extreme high and low wages, frequently, and often rapidly, succeeding one another, are the more dreadful, as they fall on a set of people not prepared by education or habits of reflection and prudence to avoid them. In the woollen trade, the case is different; wages are much more regular and steady; and the people employed in it are better able, from their education and habits, to withstand the temptation of high wages, and consequently are less exposed to the evil consequences of low wages. Such appear to us to be the chief causes of the difference so visible and general between the condition and morals of the labouring classes in the cotton and in the woollen districts: it may be added, that the cotton factories in the former are generally in large towns, and that at least, so far as respects Manchester, the principal seat and centre of the trade, a great number of Irish people are employed in it, who certainly, from the peculiarities of their national character, are as little able to withstand the temptations of vice, and of alternate high and low wages, as any race of people in the world. On the contrary, the factories in the woolen district are generally not in towns, and the people who work in them are generally natives. It is proper, however, to remark, that the filth, poverty, unhealthiness, and dissipation, which characterize, in such a striking and lamentable manner, the spinning branch of the manufacture of cotton, do not exist, in nearly an equal degree, in the weaving and other branches; many of the weavers, on the contrary, are industrious, sober, and intelligent men; and in the neighbourhood of Manchester, particularly, frequently possess small farms, which they manage along with their weaving business: these farms, it is true, are too often neglected, in consequence of their attention and time being almost exclusively devoted to their other business. (W. S.)