AMERICAN
NATURE SERIES

FRESHWATER
AQUARIUM

By J. A. Damuhn

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Leopard Frog, *Rana virescens.*
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THE
FRESHWATER AQUARIUM
AND ITS
INHABITANTS

A GUIDE FOR THE AMATEUR AQUARIST

BY

OTTO EGGELING
AND

FREDERICK EHRENBERG

WITH MANY ILLUSTRATIONS FROM NATURE

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PREFACE

To create in the aquarium a miniature waterscape with grottoes and beautiful aquatic plants, to populate it with the various multicolored inhabitants of ponds and rivers, to observe their habits, their living and loving, is indeed a pleasure and an education, not to be surpassed by anything in the same line and at so modest an expense. With the experience of recent years it is possible to keep aquariums and terrariums without suffering the frequent and continuous losses of their contents, to which amateurs were formerly subjected. Even the most inexperienced beginner may successfully keep certain species of fish, lizards or other denizens of water and forest, without more risk of loss, than he would run in the keeping of the old familiar pets such as dogs, cats or birds. To be successful as an amateur aquarist, all that is necessary is to select the varieties of fishes, lizards and
plants best adapted to confinement and home cultivation, and to observe some simple rules as to their treatment.

The present book is the result of the careful collaboration of a professional aquarist and a very enthusiastic amateur. While the professional aquarist gives his experiences collected through a quarter of a century in an extensive business, offering the best opportunity for observing fishes, amphibians and aquatic plants, both as to their habits and their merits for the aquarium, the amateur adds the result of his observation in forest and glen, and his experience under the often trying home conditions which prevail with the average amateur aquarist. We have enlarged and elaborated our own experiences and observations by selecting the best from the material of well known and recognized authorities on the subject.

We feel our purpose of stimulating interest in the aquarium, with all its wonderful vegetable and animal life, can not be furthered better than by reducing to a minimum the difficulties of its care. We have simplified therefore as much as possible the
rules for the care and treatment of the aquarium, refraining from recommending complicated implements difficult to handle and needing a good deal of care and attention to do their work well, but substituting in their place the simplest instruments, or, in many cases, dispensing entirely with their service.

We beg to express our sincere thanks to Mr. E. F. Keller and to Mr. E. R. Sanborn for their kind and important assistance in the production of this book. With rare skill and inexhaustible patience they have prepared most of our illustrations. Whoever has tried to photograph live aquatic animals in their natural element, will appreciate the difficulties to be overcome in obtaining such excellent results.

otto eggeling.
frederick ehrenberg.
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THE FRESHWATER AQUARIUM
THE AQUARIUM.

HE aquarium is a tank, reservoir or vessel, destined to be stocked with aquatic plants, fishes and other inhabitants of the water. The arrangement of the aquarium should resemble, so far as possible, the natural environment of the little prisoners. It is only in such surroundings that they will show to best advantage, and develop the numberless peculiarities and characteristics which make them so interesting to every lover of nature.

If properly equipped the aquarium is not only an attractive ornament for the home, but it also encourages the observation of nature, and much pleasure may be derived
from watching the graceful play and the queer antics of the fishes and amphibians, as they dart through the miniature forest of aquatic plants, or hide behind the stones or ornaments provided for their shelter.

It may also be mentioned that the aquarium is not without sanitary merit, as by evaporation it supplies the suspended moisture so desirable and even necessary in our rooms.

GOOD SHAPES FOR AQUARIUMS.

The shape of the aquarium is a matter of taste; it may be round, square, oblong or hexagonal, so long as it is large enough to answer its purpose. So-called fish globes used frequently for the keeping of fishes, hardly deserve to be mentioned. While in one of these globes, with proper care, fishes may live for a very limited length of time,
it is undoubtedly cruel to place them there, as the amount of water contained in the average globe is not sufficient to sustain the fish and to supply the oxygen necessary for their life. In such a vessel a very frequent renewal of the water is indispensable to the life of the fish, and this is, in itself, a great detriment, since it disturbs and irritates even the most hardy inmates of this very poor substitute for the aquarium. Another great disadvantage of the globe is the distorted picture it gives of its contents, when they are observed sideways through the glass. A further reason why the globe should be avoided is the narrow top, which greatly reduces the water surface exposed to the atmosphere. On the other hand globes of larger size are so fragile, their walls being hardly thicker than paper, that even a slight knock may break them.

Large cylindrical glass vessels in one piece may be arranged in a practical and attractive manner, but if compared with
other forms they have certain disadvantages, which should be considered, if the amateur wishes to provide a suitable home for his pets. In the first place, they break or crack very easily and apparently without any other reason than a sudden change of temperature, or when there is sunshine on one side and shade on the other. In such a case repairing is impossible. Then too, the picture which they give of their contents, while not as distorted as that from the globe, is more or less indistinct and unnatural, so that they are not advisable, where careful observation is intended.

Far better are the square or oblong aquariums, made in one piece of clear strong glass, as they give a distinct and true picture of their contents, allowing good and unobstructed observation. These, like the previous ones, also break and crack easily.
and are then a total loss to their owners. To reduce this danger to a minimum, they should be placed on a very heavy piece of felt, or on a thin soft cushion, and in such a position that sudden changes of tem-

Fig. 3. Oblong glass aquarium.

perature are avoided. This will secure an even support for the often unevenly distributed weight and pressure on the bottom of the glass and will add very considerably to the durability of the vessel.

Decidedly the best aquariums, however, are those made of a good strong iron
Fresh Water Aquarium

frame, into which plate glass is fitted and fastened with a waterproof cement. An oblong is the best shape, as it presents a clear view from every point. A substantial metal frame securely fastened to a strong slate or marble bottom, with good heavy plate glass well fitted into the frame for the sides will make as nearly perfect an aquarium as can be desired. It is of the greatest advantage to have the metal part tinned, as this will make the frame practically indestructible,
whereas, wherever the untinned frame comes in contact with the water, it soon becomes covered with rust. This rusting causes a loosening of the cement and a consequent leaking of the aquarium, so that within a short time it becomes unfit for use. Even the outside enamel lasts longer on a tinned than on an ordinary frame, on which it also is speedily destroyed by the rust, against which it but imperfectly and temporarily protects the metal. It is therefore to the interest of the buyer to see that all metal parts of the aquarium are tinned, the more so as the difference in price between those tinned and those untinned is merely nominal. Highly ornamental and durable, but rather expensive, is the aquarium with all metal parts nickel-plated, and with a glass, slate, or marble bottom. It possesses all the good qualities of the aquarium with the tinned frame with the addition of greater beauty. The oblong aquarium with a metal frame is the most popular shape of this construc-
Fresh Water Aquarium

tion, as it allows an unobstructed observation of its contents and is pleasing in appearance. It can be obtained in any size

and proportion and is frequently made to fit certain places, such as windows, tables, etc. The hexagonal and octagonal aquariums are favored for free standing tables or stands, or as center pieces for flower
tables. They have no special merit outside of their decorative effects.

A cheaper aquarium is made of a tin frame with glass sides and tin bottom.

Fig. 6. Hexagonal aquarium.

While a vessel of this construction is not suitable for large aquariums, it does excellent service in sizes up to 16 gallons. To prevent damage and eventual destruction by rust, all the metal parts of such an aquarium
should be treated with a good coating of enamel paint, at least once a year. It is most essential that the bottom be sufficiently strong, not to bend under the weight of gravel, stones and water. A certain proportion should prevail between the length, height and the width of all aquariums. If possible the height should not exceed the length and width of the aquarium, as it is important to have as large as possible a sur-

Fig. 7. Oblong glass aquarium with tin frame.
face, where water and atmosphere come into contact.

THE PLACING OF THE AQUARIUM.

To obtain the best results, the aquarium should be placed where it has an abundance of light. A position close to a window, facing east, west or north is most suitable. If exposed to the sun during the summer months or, between the hours of 10 a.m. and 3 p.m. during the other seasons, the water will become overheated, and this is frequently responsible for the loss of valuable specimens.

While small vessels may find room on a window-sill, or on a board fastened with two angle irons to the window-sill, larger and consequently heavier tanks should be placed on a strong wooden table or on one of wrought iron. To facilitate moving, the legs of the table should be furnished with castors. The weight of an aquarium of even medium size is considerable, and many
an accident will be avoided by having every facility for easy handling and moving.

Different opinions have been expressed about the influence of strong sunlight upon the aquarium. While some aquarists claim that it is not detrimental to the health of the inmates, either vegetable or animal, others claim just the reverse. Our experience is, that strong sunlight and the thereby increased temperature of the water are undoubtedly harmful, and sometimes even fatal to the more delicate fishes. Moreover the aquatic plants decay under the influence of too much sunlight and it favors the growth of the algæ, which sometimes covers the glass with an unsightly green coating. Where no other window but one of southern exposure is available, it is very easy to protect the aquarium against the sun by placing a piece of pasteboard in front of it or by keeping the shade down. During the summer months the aquarium may be placed outside the window, or in a
The Aquarium

shady part of a garden, but no perceptible benefit to plants or fishes should be expected from this change. Frequently a very rapid formation of algæ will be the only visible, if undesirable, result.

THE BOTTOM OF THE AQUARIUM.

As long as we intend to have plants in our aquariums, we have to provide some material enabling them to gain a foothold on the bottom. The opinion as to what this material should consist of, varies almost as much as to what plants are "best" for aquarium use. While it is undoubtedly true that most aquatics prefer a certain soil, and in their wild state are mostly found where this soil occurs, it is far from true that this must necessarily be provided in order to grow them successfully in the aquarium. Different mixtures have been recommended, such as loam, peat and sand, leafmold and sand, well-decayed manure, loam and gravel, and others, and it cannot be denied that cer-
tain plants do require these soils. But as we have a number of excellent plants which succeed very well in pure gravel, without any organic admixture, it is not advisable to use any of the other mentioned mixtures for the bottom covering, as they contain a very high percentage of vegetable substance, which, under the influence of moisture, will rapidly decay, making the water more or less impure. The fact that the water seems clear, by no means guarantees its purity. Decaying substances settle on the bottom, and the moving of the inmates of the aquarium stirs them up, making the water cloudy and unfit for many of the tender and sensitive fishes. Even a layer of gravel spread over the soil is no protection against the infection of the water. It may be added that the cleaning of an aquarium, the bottom of which has been covered with soil, is a very unpleasant, and not at all easy task.

Thus the cleanest and most satisfactory material for the bottom covering is a layer
of coarse gravel, so-called bird gravel, which can be obtained from every bird dealer. All dust and other impurities should be removed from it by repeated washing in clean water, before it is placed in the aquarium. It should then be spread in such a manner as to form a slanting surface, sloping, according to the size of the tank, from two to four inches on the higher, to from an inch to an inch and a half on the lower side. By turning the higher side outward and the lower toward the room, it is possible to obtain unobstructed observation of such fishes as prefer the lowest and darkest corners of the aquarium for their resting places. The main reason for the sloping bottom is that all impurities, such as excrements, remnants of food and decaying parts of plants, will gather on the lower side, from which they can easily be removed with the mud lever,—a little instrument provided for this purpose.

On arranging the bottom of the aquarium
it is necessary to provide shelter and hiding places answering the individual requirements of the different inhabitants. A great number of ornaments and appliances, differing in shape and material, are offered by dealers for this purpose. Ornaments of colored china or terra-cotta representing miniature ruins of castles, or rocks and grottoes with different openings are popularly used in aquariums of moderate size, but, while they may be tolerated where nothing better is obtainable, they should not be used where better material for the same purpose can be had. The ornaments are too artificial to blend harmoniously with the other and most important contents of the aquarium. Far preferable are ordinary, colored stones, tastefully arranged by simply grouping them together without any binding medium, or fastening them together with cement in such a way, that they form grottoes or passages with openings and dark recesses suitable for hiding places. By far the most attractive
material in the line of rocks is tufa or tuffstone, a porous aqueous product. It may be used both in its natural form as it is quarried or in the shape of arches and grottoes, constructed from small, well-selected pieces and bound together with cement. The rough surface of the tufa favors the rooting of aquatic plants and some of the natural cavities in the stone may be found large enough for individual aquatics of small size. It is most interesting to observe how the
Fresh Water Aquarium

fishes and other inmates of the aquarium take advantage of these shelters, how they dart in and out through the passages, chasing each other in endless play. Often too, smaller and weaker fishes seek and find protection from the attacks of their stronger and more aggressive companions by hiding in the small openings of the rock. Should the amateur prefer to construct his own little rockery, he must not forget to let it soak in water for a few days before he places it in position, so that all soluble mineral substances may be thoroughly extracted; substances which might otherwise be harmful to the living inmates of the aquarium. It is not advisable to introduce sea-shells into the aquarium. Being without life they are meaningless and by their slow decomposition the water may receive ingredients detrimental to the health of its animal life.

THE PLANTING OF THE AQUARIUM.

Having prepared the aquarium according to the directions given in the preceding
Fig. 9. Tufa for aquarium use.
pages, we can now begin the planting. Most of the aquatics are very brittle and easily bruised, and wounds caused by pressure upon leaves and stems never heal, but usually cause the rotting away not only of the injured parts, but also of branches and leaves coming in contact with them. It is therefore advisable to remove everything that is not healthy and intact, as well as loose leaves, adhering soil and other occasional impurities. From three to six stems should then be carefully fastened together with a soft thin band of tinfoil, the weight of which will keep them in the proper position, that is, stems down and points up. To prevent the shifting of the plants by the larger inmates of the aquarium, the stems can also be planted in the gravel, where they will promptly root. Some of our aquatics have bulbs, and these will have to be planted about an inch below the surface of the gravel. If properly selected the plants will rapidly grow and spread, and for this reason
the first planting should not be made too dense.

The plants in the aquarium serve a double purpose,—that of beautification on the one hand, and on the other the performance of certain very important physical functions. As ornaments they compare favorably with the most delicate foliage-plants of our conservatories and flower windows. Exceedingly graceful, of the most tender green, frequently shadowed with purplish or pink tints, varied in form, foliage and blossom, they more than repay the little care required for their cultivation. The delicate, almost hairlike growth found on many of the aquatic plants is one of their most desirable as well as their most peculiar characteristics, since it is elsewhere to be observed only on some mosses, ferns and a very limited number of other land plants.

Aquatic plants collected from streams, ditches and other localities, should not be transferred to the aquarium without having
previously been subjected to the most minute inspection and to a thorough washing and cleaning; for they frequently harbor pests of almost microscopic dimensions but which, when introduced in the aquarium, multiply rapidly and bring death or disease to our pets before we are aware of it.

The planting process itself is of the simplest. After the plants have been assorted as to their varieties, a deep hole is made in the gravel, from three to six stems are inserted and the gravel is then firmly pressed around the plants, so that they cannot be torn up by the fishes. In transplanting aquatics sudden changes of temperature should be avoided, as they often damage the plants. To do this, newly acquired or collected plants should be carried home in some of the water in which they have been growing. If this should be practically the same temperature as the water of the aquarium into which they are to be transferred, the change will be inconsiderable and there-
fore harmless. If, however, it should be considerably colder or warmer, the plants should be kept for a few hours in the same room and temperature with the aquarium and then planted. In grouping aquatics care should be taken that they have ample room for development, and that they are so arranged as to form the pleasing picture of a little submerged garden. They should be placed at least two inches away from the glass, so that the latter can be cleaned without damage to the plants. Now also is the time to place such plants as will grow near, and above the surface of the water, in suitable positions upon the rock. A few of the best varieties for this purpose will be described in another part of the book.

As mentioned before, plants perform certain functions of the greatest importance in the aquarium. They have to furnish the oxygen without which animal life cannot exist. Fishes, as well as amphibians, and even insects, have respiratory organs with
which they inhale and absorb oxygen and exhale carbonic acid, a gas as essential to plant life as oxygen is to animal life. At times the exhalation of oxygen by some of the plants becomes visible. Under the influence of sunlight they become covered with myriads of small silvery beads consisting of the purest oxygen. A slight moving of the plants will detach these beads and cause their ascent to the surface of the water. Thus it will be seen that an interdependence exists between animal and vegetable life, the plants absorbing carbonic acid and exhaling oxygen, the animals absorbing oxygen and exhaling carbonic acid.

It is therefore indispensable for the welfare of the animals of an aquarium, that it be stocked with plants in the right proportion. Often the amateur may suffer the loss of his most valuable fishes simply because vegetation in the aquarium is absent or insufficient, in which case either additional vegetation or an artificial aeration of the water
is necessary. If this is not provided for, the fishes will die of suffocation. Of the two ways to improve the conditions in the aquarium, new or additional vegetation is by far the cheapest and easiest remedy of the evil.

It is worth considering that vegetation is most active and vigorous in spring and the aquatics form no exception to this rule. There is therefore a certain advantage in arranging an aquarium in the spring, when within a few weeks the plants will be firmly established and fairly fill the space allotted to them, but there is no objection to beginning the work at any time regardless of the season, as long as the material can be obtained. The only difference is that during fall and winter the rooting and spreading of the plants may take a little longer.

THE WATER.

It is of the greatest importance for the well-being of vegetable and animal life in the aquarium to make use of the right kind of
water. The latter should be as clear and pure as possible and free from odor. Drinking water, as it is furnished in most cities, will usually answer the purpose, provided that it is not too hard. Water containing such mineral substances as iron, lime, sulphur, etc., is harmful, if not fatal to fishes and should therefore be avoided. But even such water can be considerably improved by being exposed in a flat vessel to the atmosphere, before being poured into the aquarium. Where other suitable water cannot be had, rain or river water can be used without the slightest danger. Even with the greatest of care the water in the aquarium after a time may have a slightly musty or swampy odor. This is caused by the vegetation and does not indicate that a renewal of the water is necessary.

THE FILLING AND EMPTYING OF THE AQUARIUM.

In filling the aquarium with water it is important that the gravel and the plants on
the bottom should not be disturbed. To prevent this, a waterglass, or other similar vessel, may be placed in the aquarium on the side where the gravel is lowest. In this the water is poured slowly and carefully until it reaches about half the height of the aquarium. Now the glass may be removed and the filling can be continued up to the proper height, but even now the water should not be poured in with too much force, as it will often disturb the gravel and wash out the newly set plants. To effect the filling without any disturbance of the contents of the aquarium, a simple implement, the filling tube, can be used. Should the water appear slightly cloudy after the filling, one or two days, or in smaller vessels even a few hours, will be sufficient to effect a settling of all floating impurities, so that it is absolutely transparent. If the aquarium is properly stocked with fishes and plants in the right proportion, a partial renewal of the water and a cleaning out of the sedi-
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ment, once a week in a small aquarium, and less frequently in those of large size, will be all that is necessary to keep everything in good condition.

It may be mentioned here that in all aquariums with metal frames the water should reach up, and slightly above the lower edge of the top border. This will hide from view the unsightly line of impurity, frequently caused by evaporation of the water, and will greatly add to the general good appearance of the aquarium. To prevent the jumping out of fishes from a tank filled close to the top, a piece of netting fastened to a wire frame the size of the top, or a fine galvanized or painted wire netting cut to fit the shape and size of the aquarium may be placed on top of it. A plate of glass is, however, preferable, as it answers the double purpose of preventing the fishes from jumping out and the dust from falling in. To admit air to the aquarium the glass should be supported by resting on the cor-
ners upon a few pieces of rubber or cork.

To empty the aquarium of the water, a piece of rubber tubing about two and a half times as long as the depth of the aquarium is necessary. The vessel which is to receive the water should be placed on a considerably lower level than the bottom of the tank to be emptied. One end of the tube is then to be placed fairly close to the bottom of the aquarium, the other end is bent on the outside slightly below the level of the bottom of the aquarium. Suction with the mouth at this end will start the flow. Anyone who may object to this method can fill the tube with water, closing the outer end tightly by pressure with the fingers, sink the open end into the aquarium and bend the outer part of the tube as low as its length will permit. The water will flow out as soon as the pressure is removed.
CHAPTER II.

AQUARIUM PLANTS.

The aquarium plants may be subdivided as follows,

- Rooted submerged plants.
- Rooted plants with floating leaves.
- Free swimming plants.
- Bog or swamp plants.

ROOTED SUBMERGED PLANTS.

These plants root in the bottom of the aquarium and either do not reach the surface of the water at all, or after having reached it, continue to grow close to, and beneath it, but without showing any part of their vegetation above the surface. Some of the submerged plants, however, develop their flowers above the surface of the water and in this case change the character of their
Fig. 10. Fanwort, *Cabomba caroliniana*. Keller, photographer.
leaves considerably. Submerged plants are especially adapted for use in the aquarium, as they grow easily and freely and as they exhale a large amount of oxygen. They also form good hiding places for the inmates of the aquarium. While the following list may not be complete it is sufficient for every purpose, as we mention all the best known and most valuable species of submerged plants. The varieties named are nearly all found in the United States.

Fanwort (*Cabomba caroliniana*) is too well known to the amateur aquarist to need a long description. It is invaluable for the aquarium, as it roots and grows very freely. With its finely divided fan-like leaves it forms one of the most graceful ornaments of the aquarium and cannot be too highly praised. The Cabomba is found wild in a good many localities and can be bought cheaply wherever aquatics are sold. The plant grows luxuriously both summer and winter and for this reason is especially val-
Aquarium Plants

Fig. 11. Pink Fanwort, *Cabomba rosafolia.*
Fresh Water Aquarium

uable. Being densely foliated it exhales a considerable amount of oxygen. It bears an ornamental white flower, blossoming above the surface of the water. These plants when taken from their native waters often carry harmful vegetable and animal parasites and in order to prevent contamination, they should be subjected to a thorough washing in salt-water, before being transferred to the aquarium.

Pink Fanwort (*Cabomba rosaefolia*) resembles Cabomba caroliniana in all essential parts without being quite as valuable. The plant has a dark pinkish color and is very ornamental, especially when new branches form. These are of a much brighter color than the older parts of the plant.

*Cabomba rosaefolia* roots more slowly than the first variety and is inclined to soften and rot.

The Cabomba seldom ripen their seed under cultivation, but they propagate very easily through cuttings or branches, which
Fig. 25. Swamp-growing False Loosestrife, *Ludwigia palustris*. See p. 58.
Fig. 16. Hornwort growing in aquarium, *Ceratophyllum demersum*. See p. 40.
Fig. 12. Mermaid Weed, *Proserpinaca palustris*. 
will root readily and without much care. They will not, however, thrive well in hard water containing lime. Cabomba rosæfolia falls an easy victim to vegetable parasites such as algae.

Mermaid Weed \((Proserpinaca palustris)\) is a graceful aquatic with finely divided leaves, arranged around the stem in alternating order.

The stems are slender and pliable. It will show to best advantage when planted not in bunches, but in single stems. It is a good oxygenator and grows very well in gravel, and better in winter than in summer. It is found very abundantly around Philadelphia, but is also wild and more or less common throughout a large part of the United States.

Willow Moss \((Fontinalis antipyretica)\) is the best of several varieties which are rather difficult to distinguish. It is well known as a good aquarium plant. As it is one of a limited number of aquatics, which remain
green and healthy through all seasons, it is of great merit. In nature this plant is found in slow-flowing, shaded streams, growing on stones, roots and old timber,
where it forms good and welcome hiding places for many of the small inhabitants of the water. It is common all over the United States.

Fontinalis is one of the largest aquatic mosses and forms dense masses, ranging in color from a bright, to an almost blackish olive-green. The stems are about one foot long, frequently and irregularly divided. The leaves, which resemble large scales, are placed densely around the stem. Fontinalis antipyretica, as the scientific name indicates, was valued as a preventative and a cure for scalds and burns.

*Fontinalis delacarlica* is of a more delicate growth and has smaller leaves than the previous variety. It is of less value for the aquarium than Fontinalis antipyretica, as it is soft and of little resistance. It should not be used as long as the other variety can be obtained.

Common Starwort (*Callitriche verna*) is a valuable plant for the aquarium, where it
Aquarium Plants

Fig. 14. Fontinalis denticula.
Fresh Water Aquarium

thrives well and without special care. Its light green leaves are narrow on the lower part of the stem, but reversed ovate on the upper end, where they form little star-shaped rosettes which rest on the surface of the water. The plant will last for years, and is one of the aquatics on which plant-eating fishes prefer to feed. The Callitriche are found in ditches and ponds in stagnant and slowly flowing waters.

**Fall Starwort** (*Callitriche autumnalis*) has a denser and slightly darker foliage than *Callitriche verna*, which it otherwise resembles. The Callitriche should be planted in single stems.

**Hornwort** (*Ceratophyllum demersum*) can be well recommended for the aquarium. It will continue growing, if simply thrown in the water, as it has very small roots and will not take a firm hold of the gravel. A band of tinfoil wound round the lower end of the stem will hold it down to the bottom. As the young growth of the Hornwort is
much more graceful and more brightly colored than the old or lower part, it is well to cut the lower part off as soon as the top nears the surface, and then replant the top.
Fig. 17. Hornwort as growing wild, *Ceratophyllum demersum.*
During the winter this plant is only partly green. (See Fig. 16, page 35.) The leaves surround the stem in whorls and are very finely divided in almost thread-like filaments. It is one of the most common pond plants, found in most parts of the United States, but varying considerably according to its habitat. In southern waters it grows very much denser and darker, even with a reddish tint, so that it looks almost like a different species.

**Canadian Waterweed** (*Elodea canadensis*) is a rank grower, forming a network of long slender branches with three or more small leaves arranged around the stem in circles. The young branches are of a light bright green. It grows most readily, even from the smallest piece of stem with some leaves thrown in the water, but it is preferable to fasten the stems in the bottom gravel. As it is inclined to a very rapid growth, it has to be watched and pruned, to prevent its encroaching upon the sites of other and pos-
sibly better plants. It is common all through the United States.

**Fig. 18.** Canadian Waterweed, *Elodea canadensis.*

**The Dense Waterweed** (*Elodea densa*), a species said to be introduced from South America, is of a more robust and, as the
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name indicates, of a denser growth than Elodea canadensis. It possesses all good

Fig. 19. Dense Waterweed, *Elodea densa*.

qualities of the former species and even surpasses it in beauty. This plant is not gen-
erally known, but deserves the highest recommendation. In this case, too, the growth should be watched, as it may encroach upon its less vigorous neighbors.

**Narrow-leaved Waterweed** (*Elodea angustifolia*) is a native variety of great beauty and hardiness. The thin stems are densely covered with narrow, pointed leaves, dark green on the older, but bright light green on the new growth. The plant shows considerable variation, which may be caused by habitat or season, or possibly by both. We have found the leaves strongly curled, so that we were tempted to regard the plant as an undescribed species; but careful comparison with specimens from different localities proved to us that our plant was *Elodea angustifolia*. It is a very desirable aquarium plant, comparing favorably with other species.

**Tape-grass** (*Talisneria spiralis*). This is a most valuable aquarium plant, and an easy and free grower. The bright green grass-
Fig. 20. Narrow-leaved Waterweed, *Elodea angustifolia*. 
like leaves, supported by the water, grow upright, without appearing stiff. The roots are fibrous and take a firm hold in the gravel. The plants are of different sexes and can be best distinguished by the flowers which appear late in summer. The female flower is supported by a long slender stem and appears as a green calix. When flowering it stands slightly above the level of the water.
The male flower has a very short stem and, before opening, resembles a small green capsule. To cause the fertilization, the male flower separates itself from the stem and mounts to the surface of the water, where it opens, and floating, carries the pollen to the female flower. After the fructification is accomplished, the stem of the female flower contracts into a spiral, thereby submerging it, so that the seed ripens under the water.

Outside of the flowering season it is not easy to distinguish the sexes. Usually the leaves of the female are broader and darker than those of the male plant. There is also a difference in the formation of the roots. While the root fibers of the female plant are bunched around a bulblike knot, those of the male plant are placed on a somewhat elongated central stem.

The Valisneria is easily propagated from runners which extend from the older plants in all directions. If planted in an aquarium
they should be given ample space so that they can spread without too much crowding. They are equally valuable and ornamental during all seasons and grow well in warm and cold water. In an aquarium with abundant light, the runners of the Valisneria will grow close to the bottom, whereas in a darker position they will grow more or less upright to reach the light as quickly as possible. Valisneria is found wild in rivers, canals and shallow lakes in the eastern parts of the United States.

**Waterviolet or Waterfeather** (*Hottonia palustris*). This is a very graceful plant with light green, deeply laciniated leaves placed in whorls around the stem. The ornamental, white flowers appear in summer growing straight upright out of the water. The plant itself is rather brittle and delicate, and to be at its best, should have sandy loam for a bottom. Hottonia can be propagated from seed, or so-called winter-buds, a form of much condensed branches which grow dur-
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ing the fall and, sinking to the bottom, develop into new plants in spring. This plant is found in ponds, pools and bogs in wooded localities and begins to grow as soon as the water is free from ice.

Mudplant or Kidney-leaved Heteranthera (*Heteranthera reniformis*). Although originally found in swamps, this plant should have a place in every aquarium, regardless of size or arrangement, as it grows remarkably well and is highly ornamental. The leaves are elliptical or faintly kidney-shaped, of a very pleasing yellowish green or light olive color, forming dense masses after being well established. The ribs radiate from the stem in a starlike pattern. This plant grows freely from cuttings and lasts well throughout the winter. This Heteranthera is found in shallow rivers, ditches and ponds, in the warmer parts of North America.

Seagrass-leaved Heteranthera (*Heteranthera zosteraefolia*), a variety from Brazil, is
Fig. 22. Mudplant, *Heteranthera reniformis*. 
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of considerable beauty and merit. It grows well where it has a sufficiently high temperature.

Pondweed (Potamogeton) is found in many varieties all through the United States. While most of them may be very interesting to the botanist, only a limited number are of actual value to the aquarist. It is not easy to distinguish the different pondweeds, as location, light and quality of water cause remarkable changes in the color and shape of the leaves. One of the best varieties is the,—

Wavy-leaved Pondweed (Potamogeton crispus). As the name indicates, it has wavy leaves, submerged and varying considerably in length, shape and even in color. The latter, if normal, is a brownish green but through the influence of light and quality of water it may change to a bright clear green, while the usually wavy and curly leaves may become almost flat, so that the original species can hardly be recognized. The plant
Fig. 23. Wavy-leaved Pondweed, *Potamogeton crispus*.

branches freely and forms so-called winter-buds, looking like small burrs. After maturing, these buds sink to the bottom and
form new plants. The easiest and quickest way to propagate the plant is to take branches and plant them in sand or in a mixture of sand and soil. The blossoms of the Potamogeton are not ornamental and may be removed before they develop. All Potamogetons are good oxygenators.

*Potamogeton perfoliatus.* This pondweed has much shorter leaves than Potamogeton crispus. They are generally ovate and slightly serrated near the point. The stem grows through the base of the leaves, which form a rather dense growth and are all submerged. It grows very well even in small aquariums and keeps remarkably free from algae.

*Dense Pondweed* (*Potamogeton densus*) remains bright green in the aquarium all winter. It has two kinds of leaves. Those growing under water are long and slender, almost ribbon-shaped on the base; but as the plant grows, reaching the surface of the water, it forms swimming leaves, which are
oval, slightly heart-shaped on the base, of a brownish color and a leathery appearance. The submerged leaves disappear as soon as the floating leaves form.

*Potamogeton amplifolius.* This pondweed, of which we give a photographic reproduction, is one of the best aquarium plants, a splendid grower, a good oxygenator and highly ornamental on account of its graceful form and its exceptionally vivid green color. One who has collected the plant in its native waters will hardly recognize it in our picture. Only the few bottom leaves, grown before it was collected, indicate its normal form. The after growth made in the aquarium differs so radically from the wild plant that it would never be taken for what it actually is. While all Potamogetons are subject to variations caused by the habitat and local conditions, we never observed so considerable a change as in this case. It would be interesting to see, if the plant, when transplanted from the aquarium to outside
Fig. 24. *Potamogeton amplifolius.*
waters, would revert to the typical wild form.

Swamp-growing False Loosestrife (*Ludwigia palustris*). Of all the different varieties only those enumerated here are of value to the aquarist. *Ludwigia palustris* has pointed, oval leaves of a bright green color, shaded with a brownish pink wherever exposed to the light. The leaves are placed alternately along the stem. (See Fig. 25, page 35.)

*Ludwigia mulertii* is very much like the above variety. The greatest difference is in the longer leaves and in the more intense color which, if exposed to the light, turns to a deep red. The Ludwigias will not grow well in a dark place. If they have not a generous amount of light the leaves will decay, leaving the stems bare, and forming small pale leaves only on the extreme points of the plant.

*Ludwigia hirtella* is found in rivers and ponds all through the United States. Dur-
Fig. 26. *Ludwigia mulcrtii.*
The Narrow-leaved False Loosestrife (Ludwigia linearis) comes from the waters of Florida, and while it is not a true aquatic, it will do very well, if the stolons only are used for the aquarium. These stolons start from the base of the plant and form long, slender, graceful branches, which, if placed in the aquarium continue to grow well. The leaves of this species are long and oval, and placed densely around the stem, which is of a clear green color. The leaves are dark green above and of a more or less intense red below. The brighter the light the more conspicuous the red.

To keep this Ludwigia in good foliage, the flowering should be prevented by removing the stem as soon as it appears. If allowed to grow above the water it will deprive the stolons of their nourishment, causing
Fig. 27. Narrow-leaved False Loosestrife, *Ludwigia linearis*. 
the leaves to drop and the plant to cease to be attractive.

**White Water Crowfoot** (*Ranunculus aquatilis*) is found in slowly flowing streams and stagnant waters. It grows fairly well in the aquarium, where its finely divided leaves, with their kidney-shaped outline, are quite ornamental. The submerged leaves resemble those of the Cabomba to some extent, but the *Ranunculus* is much looser in growth. As soon as the plant reaches the surface of the water, the character of the leaves changes to an irregularly-lobed bright green form with a smooth glossy surface, and the delicate white blossoms appear soon after.

**Divaricated Crowfoot** (*Ranunculus divaricatus*) is found in the same localities as the *Ranunculus aquatilis*, but not quite so commonly. All the leaves are submerged, of almost circular outline and very short stemmed. The flowers are white and long-stemmed and appear during the early sum-
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Both varieties, if carefully collected and transplanted in spring, will last for quite a while and if put in a light place will flower well.

**Water-aloe, Water-shears (Stratiotes aloides).** This plant is an introduction from Europe, where it grows in stagnant and slowly flowing waters. The plant is distinguished from most of our aquatics by its peculiar aloelike appearance. It is quite large, the leaves are gathered into a dense rosette, submerged, or with only the points of the leaves above the surface of the water. The flowers, which are white, three-leaved and quite prominent, rarely appear in the aquarium. The male and female flowers appear on separate plants. The easiest propagation is through runners which form freely. The plant floats in the water or can be planted in the gravel. It is highly decorative during the summer. In fall the leaves die down and the plant forms the so-called winterbuds which rest dormant in the
muddy bottoms of their natural habitations. In a fairly high temperature the leaves may remain green during the winter, forming a very attractive aquarium plant.
Fig. 29. Small-fruiting Nitella, *Nitella microcarpa.*
Small-fruited Nitella (*Nitella microcarpa*) is a very graceful, but rather delicate aquatic. The greatest of care should be taken in transplanting it from its native waters into the aquarium, as the threadlike stems are very brittle, sensitive to bright sunlight and sudden changes of temperature. To insure safe transportation, it should be carried in water. It is especially interesting in being one of the few plants which will show the circulation of the sap under a fairly strong magnifying glass.

Swimming Arrow-wort (*Sagittaria natans*) is one of our native aquatic plants, and must be counted under those of special merit. As long as the plant is young, the leaves are completely submerged, rather narrow and ribbonlike, and therefore very much like those of the Valisneria. Only a peculiar curvature distinguishes them from those of the latter plant. The long oval swimming leaves seldom develop in the aquarium, and only after a long growing period, when they
appear simultaneously with the small white flowers. The Swimming Arrow-wort grows very well under almost any conditions, and will even keep on growing during the winter, if kept in a moderately warm room.
The Creeping Rush (*Juncus repens*) comes to us from the Southern States. The flat stems spring from a fanlike bundle of narrow leaves of a very light, bright green. After a short growth new little fans form on the stems and continue to sprout and to spread until the plant appears more or less as a little bush, of exceedingly graceful appearance.

Fine threadlike rootlets form at the base of the bunches of leaves, so that the propagation consists simply in cutting off the bunches, with part of the supporting stem, and in planting them wherever they are wanted in the aquarium. We have never observed the plant above the surface of the water, and we have also failed to notice any sign of flowering. In its wild state this Juncus accommodates itself to local conditions in that, wherever it happens to become submerged, it will show the same form of growth which we see in the aquarium. As soon as the water recedes, however, or when growing from seed on moist but not sub-
Fig. 31. Creeping Rush, *Juncus repens*. 
merged ground, it forms a dense, short, grass-like plant and flowers like all other members of this large genus.

**Water Milfoil or Thousand-leaf** (*Myriophyllum heterophyllum*) is a native of the northern United States, where it is found in ponds. It is an exceedingly graceful plant with very finely divided, feathery leaves which surround the stem in whorls of from three to five. It is a hardy aquarium plant and generates plenty of oxygen. It grows well in gravel and is satisfied with a moderate amount of light. It is easily propagated from the ends of the rapidly growing stems, which, when cut off and placed in the bottom gravel of the aquarium, will soon root and often grow so fast that a thinning out may be necessary. It grows well during the winter, but should not be planted in dense bunches.

**Pinnate-leaved Thousand-leaf** (*Myriophyllum pinnatum*) is a native of the southern states where it is found in ponds or slow-flowing
Fig. 32. Pinnate-leaved Thousand-leaf, *Myriophyllum pinnatum*.

waters. While it resembles our native species in all essential points, the whorls of leaves are closer together, making the ap-
pearance of the plant slightly more compact. It is also less inclined to grow outside the water; thus keeping the submerged part in better foliage. We have frequently noticed that Myriophyllum pinnatum closes the season's growth with an especially dense cluster of leaves.

*Myriophyllum laxum*, also a southern plant, is by far the most attractive and graceful species of the genus. The filaments of the leaves are like the finest threads, giving the plant the appearance of the most delicate lace. Our specimens, obtained from different sections of Florida and the waters of other southern states, show a great variation of color, ranging from the most fiery red extending to the extremest point of the leaves, to a dark brownish red, this color being uniform over the whole plant. Other specimens showed bright red stems, while the leaves were dark green, forming a beautiful contrast, unparalleled among aquatic plants, and only comparable with the color of some
of our greenhouse foliage plants. This variety of color is most likely caused by the amount of sunlight to which the plants have been exposed. In the aquarium they may fade to some extent, but enough color will remain to make them a conspicuous and attractive addition to our aquarium flora.

*Monniera crenulata.* This interesting
Fresh Water Aquarium

plant, from southern waters, is of rather recent introduction as an aquarium plant, and as far as we have observed it is most promising. The broad oval leaves are placed in pairs around a thick fleshy stem, in such a way that each pair stands in right angles to the previous one. The pairs are close together and each leaf half surrounds the stem. Five main ribs start from the base, branching outward and toward the point of the leaf. The color of the leaves varies from a somber olive to a bright green. The whole plant has a pleasant odor somewhat resembling that of a ripe lemon. The flowers are inconspicuous.

In Monniera a plant of a new form and character is introduced in our aquariums. The stems will grow rapidly and when reaching the surface will lie flat on the water. While the short, dense, newly-planted branches seem rather stiff, a few weeks of good growth will transform them into a very graceful, desirable addition to our aquatics.
ROOTED PLANTS WITH FLOATING LEAVES.

Fragrant Dwarf Water-lily (*Nymphaea odorata minor*). Of all the many beautiful varieties of this family only this one may be tried and that necessarily in large aquariums, in which it often produces its fragrant white blossoms. In order to facilitate its flowering, the aquarium should have a sunny position. This lily is a native of North America, where it grows in shallow, stagnant waters. The leaves are heart-shaped at the base, of an almost round outline, dark green with a reddish brown border. The *Nymphaea* needs a rich soil in which it may root firmly. The easiest and safest propagation is through seeds, which are germinated in a glass jar of water, with a bottom covering of mold. Placed in the light in a moderately warm room, the young plants will soon be strong enough for transplanting.
The Sea-can or Floating-heart (*Limnanthemum nymphaoides*) is a native of Southern Europe and Asia. The creeping root throws out long runners from which the long-stemmed, floating leaves grow. The
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latter are almost circular with a deep narrow cut near the point of attachment. Their upper surface is dark green mottled with brown. The large flowers are of a beautiful golden-yellow color, with darker center stripes. They are deeply lobed, and hairy towards the center. During the summer months the Limnanthemum will grow well and flower in a large aquarium. It passes the winter in a dormant state. To thrive well it should have good, rich soil and plenty of sunlight.

*Water-key* (*Limnocharis humboldtii*) comes from South America. It is a fine and durable plant, growing well even in small aquariums. The floating leaves are broad, almost circular oval, heart-shaped at base, and with a very short point at the end. The middle rib is strongly pronounced. The flowers are large, of a beautiful yellow and have three petals. This plant, like the previous one, needs rich soil and a rather sunny position.
Fragrant or Double Water-ear (*Aponogeton distachyus*) was introduced from South Africa, but is quite hardy and well adapted for use in the aquarium. The leaves are long-stemmed, long oval, bright green on the upper surface and pinkish below. Under proper treatment the plant will grow well in both summer and winter, and develop its peculiar white and highly fragrant flowers.
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placed on a bifurcated stem. After the flowering they sink below the surface to ripen their hard seeds. The plants need plenty of light, a loamy soil and the temperature of a living room. They propagate from both seeds and roots.

**Water-nut** (*Trapa natans*), formerly of frequent occurrence in the ponds and swamps of Germany, but now quite rare. The black seed, or nut, has four strong thorns and a chestnut-like kernel. The seed will germinate if placed in a glass of water in a cool, but not cold room. A thin stem, with finely divided leaves placed in pairs, will appear first and wind its way toward the surface of the water, where it will form a rosette of floating leaves, which are strongly dentated, of leathery texture and reddish color. In June the small white flowers appear at the base of the leaves, where they form seeds. The plant is an annual, and is one of the most interesting of our aquatics, well deserving a trial in the aquarium.
Fig. 36. Water-nut, *Trapa natans*.
FREE FLOATING PLANTS.

Free floating or swimming plants are all those which do not fasten their roots in the soil, but float freely in or upon the water. Some have hardly any roots at all, others send their long, threadlike roots down to the bottom. Several of the floating plants are good oxygenators, while others are very beautiful and highly decorative.

Common Bladderwort (*Utricularia vulgaris*) is one of many varieties, all very interesting and handsome. While this plant may form roots, it is always to be seen floating close to the surface of the water. The leaves are finely laciniated, almost feathery. They carry bright green blisters or bladders which contain air and keep the plant floating.

The flowers of the Bladderwort are yellow, quite ornamental and of an unusual shape, resembling to some extent a small orchid flower. The plant under favorable
conditions grows rapidly and blooms late in summer or early in fall, the blossoms growing above the water surface. It is an annual and, for its propagation, forms winter-buds, from the size of a peppercorn to that of a small hazel-nut. After maturing, these buds should be collected and hibernated in water in a cool, but not cold room. In early spring they should be placed in the sunny window of a warmer room, when the young plants will soon begin to grow. It is then time to transfer them to the aquarium itself.

This plant is especially interesting in being one of the so-called carnivorous plants. The bladders, which keep the plant floating, are of a peculiar construction, having a kind of trapdoor, opening under pressure from the outside toward the inside, thereby allowing small animals, such as tiny fish, Daphnias, Cyclops, etc., to enter, but making the exit impossible, as pressure from the inside only serves to close the little door the firmer. Once within, the little prisoners perish and
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are absorbed as nutriment by the plant. Should the intruders become aware of their danger and attempt to turn back, before entering the trapdoor, they are prevented by a number of stiff bristles growing inside the bladder and pointing down, so that entrance is an easy matter, but exit impossible. It is not advisable to place this plant in any vessel serving to hatch fish, as according to careful observation quite a number of the young fry are caught in the bladders.

Southern Bladderwort (*Utricularia americana*) resembles in most points the previously described species, but its growth is considerably denser and its color brighter, being a beautiful rich green, distinctly different from that of *Utricularia vulgaris*. The air-bladders are slightly larger, and appear after the plant has attained a certain age. The flowers are so like those of the common bladderwort that no further description is required.

Frogbite (*Hydrocharis morsus-ranae*) was
Fig. 37. Southern Bladderwort, Utricularia americana.
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introduced from Europe, where it grows in both stagnant and flowing waters. The

Fig. 38. Frogbite, *Hydrocharis morsus-ranae*.

leaves are long-stemmed, floating, heart-shaped and almost circular in outline. As soon as the plant is started it sends out run-
ners in every direction, forming new plants and bringing forth the larger three-leaved male, and the smaller female flowers. Both are white and supported by long, slender stems. The hair-like roots hang down in the water.

Propagation can be effected by runners, or through winter-buds, which require the same treatment as those of Utricularia. Hydrocharis can be well recommended to aquarists, not only as an aquatic of easy and rapid growth and of great beauty, but also as a plant greatly favored by vegetarian fishes, amphibians, snails and other inhabitants of out and indoor aquariums.

Small Duckweed (*Lemna minor*) with its little bright green oval leaves is too generally known to need a long description. It grows in springs or shallow ponds wherever the water does not flow rapidly, frequently covering large surfaces with a solid green coating. Every leaf forms one little rootlet which hangs straight down into the water.
Once introduced in the aquarium it will multiply rapidly. The fishes eat it freely, possibly not so much for its own sake as for the amount of animal substance attached to it.

Three-leaved Duckweed (*Lemna trisulca*) grows all over the United States, but not so commonly as does *Lemna minor*. It is, however, of greater decorative value than the former. The leaves are oblong, pointed on both ends and grow cross fashion at right angles to each other, presenting an unusual appearance. Without much trouble both *Lemna* can be renewed in spring from outside waters, but it is not difficult to hibernate a few of the little plants, thereby securing an early and generous supply for the aquarium.

Floating Salvinia (*Salvinia natans*) is a native of Europe, but is sometimes found in the southern United States. It is a water fern and one of the finest of our floating plants. It has two kinds of leaves, those
growing on top and slightly out of the water, and the submerged leaves. The first are broad and oval, of a glaucous green color and covered with hairs which give them a velvety appearance. The submerged leaves are frequently mistaken for the roots of the plant, as they are finely divided into hair-like segments and are radically different
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from the other leaves. Salvinia natans is an annual. It forms spores, which, during the winter, rest on the bottom of the aquarium, from which they can be removed with some of the soil or sand, to be kept in a separate glass for spring germination. With sunlight and a fairly high temperature it may be possible to hibernate some of the plants until spring, when they will grow rapidly.

Moss-fern (*Salvinia auriculata*) grows wild in North America. It is a very graceful annual of moss-like appearance, growing best in a covered aquarium, where it not only fills the surface of the water but runs up the rocks as far as they remain moist. Its color varies according to the light, from green to different shades of pink and even red. This plant has to be renewed or raised from spores every year.

Floating Riccia (*Riccia fluitans*) is, like the previous plant, cryptogamous,—which means that the sexual organs are not dis-
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 distinguishable with the naked eye. It differs from the moss-fern in that it does not expand into leaf shape. With its bright green threadlike branches it forms more or less dense masses which are ornamental and interesting. Under favorable conditions

Fig. 41. Floating Riccia, Riccia fluitans.
the plant will remain green all through the winter. It is quite valuable as an oxygenator.

Shell Flower (*Pistia stratiodes*) is a tropical aquatic and needs a higher temperature than we usually have in our rooms. Dur-
ing the hot summer months it will grow well and develop its shell-shaped leaves of a light, velvety green, in beautiful dense rosettes. The leaves have strong parallel ribs and are covered with short dense hairs. Under favorable conditions the Pistia multiplies very rapidly through runners sent out in every direction and ending in young, rapidly growing plants. While it will grow well during the warm season, it is rather difficult to hibernate, as it has to be potted and placed in a warm room, or better still in a greenhouse.

**Water-hyacinth** (*Eichornia crassipes*) is well known in southern waters and is a very beautiful plant indeed. The pointed, kidney-shaped leaves are of a bright glossy green and are borne by strong stems, which below the leaves expand into a balloon-like swelling. The roots form in dense bunches and hang down into the water. In the aquarium only strong plants and these only under favorable conditions will develop the
Fig. 43. Water-hyacinth, *Eichornia crassipes*. 
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very conspicuous flowers, which are violet with a bright yellow spot.

The Eichornia is propagated from runners which form freely. It is not advisable to attempt hibernation outside of a greenhouse, as the plant should be potted and kept warm. It may remain in the water if the temperature is high and the location sunny.

*Trianca bogotensis*, a native of tropical

South America, is a plant of great beauty and merit for the aquarium. It is peren-

Fig. 44. American Frogbite. *Trianca bogotensis.*
nial, but difficult to hibernate. The leaves, broad, heart-shaped, form a rather dense rosette. If grown in a light place they will show brown stripes on a green ground. It propagates by runners ending in new plants. In a high temperature the Trianea reaches a much larger size than in the cold aquarium, so that it seems like quite a different plant. During the summer it will do well in a sunny pond or basin.

Arrow-wort (*Sagittaria sp*?). This comes with other aquatics from Florida. The plant, as far as observed here, grows completely submerged. While the flower stem appeared on several specimens we have never had an opportunity to see it come to perfection. The plant in itself with its dra-æna or yucca-like leaves is interesting and ornamental enough to deserve a conspicuous place in the aquarium. It is of a bright green color and succeeds well under ordinary conditions.
Fig. 45. Arrow-wort, *Sagittaria sp.*
BOG OR SWAMP PLANTS.

While the bog plants may not be of much value for the small aquarium, they can be used to great advantage in larger vessels if provision is made for water of different depths and for the soil necessary for their cultivation. Some varieties are highly decorative. The following are especially adapted for the aquarium and therefore recommended for a trial:

The Water Plantain (*Alisma plantago*) is quite common in our waters. While the submerged leaves remain small and narrow, those elevated above the surface on long, slender stems are large, pointed ovals, with an almost heart-shaped base and five to seven plainly defined parallel nerves. The root is perennial, bulbous and covered with hairlike rootlets. The flower-shaft bears a very loose pyramid of branches growing in whorls around the main stem. The flowers, which appear between July and August, have
three small petals of a very light pinkish color.

**Common Arrow-wort** (*Sagittaria sagittæ-folia*) is found in swamps, ponds and ditches all through the temperate zone. The leaves of this plant vary greatly in shape. In deep water long and narrow ribbon-like leaves appear first, followed by others of spoon shape, borne by a distinct stem, while late in spring appear the characteristic arrowhead shaped leaves. The triangular stalk bears numerous flowers; those nearest the top are large, white and pollen-bearing, the lower branches bearing pistillate or female flowers, which are smaller and less conspicuous than the males. While the *Sagittaria* appears to be an annual, the old root develops runners ending in a small bulb destined to propagate the plant.

*Sagittaria sagittæfolia flore pleno* is a beautiful variety with double flowers.

**The Chinese Arrow-wort** (*Sagittaria sinensis*) is even more beautiful and valuable than
the above species. The young plant resembles the Valisneria in appearance, but its leaves are thicker, and are triangular in cross-section. The perfect leaves are not arrow-shaped, but of spoon, or long lance-head shape. In good light the plant remains green during the better part of the winter and the flowers appear as long as the leaves last.

**Arrow-wort** (*Sagittaria montevidensis*), from Montevideo, is a very fine plant for the aquarium, being of a strong growth, with leaves of the true arrow-head shape. The flowers are large and white with dark purple blotches. In a favorable, that is, in a very sunny location, it remains green all winter.

**Sanford's Arrow-wort** (*Sagittaria sanfordii*) with broader leaves, and *Sagittaria subulata*, with smaller and finer leaves, are both of value for the aquarium, but not more so than other more or less well known varieties.

**Heart-leaved Pickerel Weed** (*Pontederia*
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cordata) is a rather coarse, native, herbaceous plant. The large glossy leaves are heart-shaped with a sharp point, sometimes arrow-shaped or oval. The flowers are borne in dense ears and are blue with yellow blotches. Pontederia cordata is quite hardy and can be hibernated in the open ground with a very slight covering. It can be propagated without trouble by dividing the plants.

The Alternate-leaved Cypergrass (Cyperus alternifolius) is as graceful and decorative as it is easy of culture in a warm room. The long slender stems bear the leaves in a miniature palm-like head, from which young plants sprout freely after they reach their full development. If cut off and planted in small pots they will quickly root and be ready for transplanting in the aquarium, either on the rock or in the bottom, if the water is not too deep. The variety with variegated stems and leaves is very beautiful, but a little more delicate than the green form. Cy-
perus alternifolius can be used for aquariums of medium size.

The true Papyrus, *Cyperus papyrus*, the plant that furnished the material for the Papyrus rolls of the old Egyptians, is highly decorative, but to grow well, it requires large vessels, and thus is hardly adapted for use in the aquarium of ordinary size.

**Water-feather** (*Myriophyllum proserpinacoides*). This Thousand-leaf is a South American species, in shape not unlike the other *Myriophyllum* enumerated under submerged plants. The leaves surround the stem in whorls of from three to five. They are divided into fine filaments arranged in comb shape on both sides of the middle rib. This plant, while not suitable for the small aquarium, will be found valuable for larger vessels, where it can be planted so that it can grow above the surface of the water. Here it will develop very rapidly the long slender stems with their light, almost yellowish foliage. Sometimes and under a strong light
Fig. 46. Water-feather, *Myriophyllum proscrpinacoides*. 
the plant appears slightly glaucous. No attempt should be made to keep it submerged. **Pipe-wort** (*Eriocaulon compressum*) is a bog plant from the Southern States. While the illustration shows fairly well the shape...
of the plant, its graceful form strongly resembling that of a Dracaena or Yucca, it cannot do justice to its color, which is a clear light green.

While the Pipe-wort in its wild state prefers swamps and bogs, where it is only partly and temporarily submerged, it does quite well under water in the aquarium and will last sufficiently long to make it a very desirable addition to our aquarium plants. It roots in the gravel and propagates from side-sprouts. The small flowers have no decorative value and the long slender and leaf-clad stem bearing them should be removed as soon as it forms.

To appear at its best, the plant should be kept fairly free, and uncrowded by other vegetation.

*Dulichium arundinaccum* is a handsome, decorative plant of a deep green color. While a bog plant, it may be used in large aquariums, where it will root in the gravel, forming its numerous graceful and slender
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Fig. 48. *Dulichium arundinaceum.*

shoots under water. Their rapid growth soon brings them to the surface and outside the water, where they will continue to grow if left undisturbed.
CHAPTER III.

THE INHABITANTS OF THE AQUARIUM.

While there may be a very limited number of amateur aquarists who make it their object to fill their aquarium with members of the vegetable kingdom only, the great majority find most interesting the combination of vegetable and animal life, or even the latter only. The great charm of the aquarium is that it enables us to observe the varied animal life of rivers, ponds and ditches,—their living, mating and propagating, and their wonderful metamorphosis.

FISHES.

Of all the different groups of the animal kingdom represented in our aquariums, that
of the fishes is the most important. In enumerating the many different varieties the practical side only is considered, the scientific classification being of less importance to the aquarist, than the knowledge of treatment and the selection of the varieties, which can live together without damage to one another.

The beginner has to face certain questions which are not easily answered. In the first place, he has to be very careful in the selection of his fishes, so that their size may be in proportion to the size of the aquarium. Then the individual requirements of the different varieties,—as to food, temperature and light have to be considered, and care has to be taken, that a sufficient amount of oxygen is provided, as the lack of this all important element is more fatal to fishes than almost any other form of neglect.

The answer to the very important question about the selection of such fishes as may be placed together in the same aquarium depends upon the conditions under which they
The Inhabitants of the Aquarium

have to live. In a large aquarium, with good and numerous hiding places for the defenseless fishes, some carnivorous varieties may be placed, but to secure peace and harmony, a sufficient amount of food should be provided for them, and care should be taken that the weaker and defenseless fishes are at least equal in size with the others. It is generally preferable, however, to keep carnivorous fishes and such as are born fighters apart from the others. This done, the damaging and crippling of the more delicate and peaceful fishes by the voracious robbers is made an impossibility. It is, as a rule, advisable to stock the aquarium with fishes of rather small size, as they will not only thrive better than the larger ones, but will also appear to better advantage, as they are more in proportion to the size of the average aquarium, than large specimens which often become damaged by collision with sharp stones or with the glass. A further advantage is, that of the smaller fishes a greater
Fig. 49. A typical fish and its fins.
The Inhabitants of the Aquarium number, and consequently a greater variety, can be kept in an aquarium of moderate size.

To facilitate the description, the illustration shows the different external parts of the fish and the terms used in the text for their designation.

Of all fishes the Carp family furnishes the most valuable and showy varieties for the aquarium.

The Gold Fish (Carassius auratus) is by far the best known and the most popular of all aquarium fishes. It is very closely related to the carp and shares some of its most important qualities, such as long life, great hardiness and easy and quick propagation. Great gold fish hatcheries exist in Maryland, New York, Ohio and Indiana, but even with the immense numbers of fishes coming from these states, the demand exceeds by far the supply, so that after the American hatcheries have exhausted their stock, we have to supply the market with large quantities of gold fish from Italy, where they are hatched and
raised in vast numbers. The Italian fishes are unusually well colored, but the long voyage often causes heavy losses.

The color of the gold fish is subject to many variations. From an almost deep golden red in some, it changes to pale yellow in others, while silver-white, pearl-gray, dark-gray and velvety black are not unusual, all of these shades being frequently seen in more or less irregular combinations on one fish. Not less varied than the color, is the shape of the gold fish, graceful and slender in some varieties, and short and al-

![Gold Fish, Carassius auratus.](image)
most globular in others. All, regardless of shape and color, are suitable for the aquarium. For some time after hatching the young fish have a yellowish brown color, which, in some cases, begins to change after two or three months; others keep this color for a considerable length of time; cases have been observed in which the change has not taken place until after one or even two years, while some specimens have kept their original color altogether, showing thereby a tendency to return to the character of the carp ancestor. Those which do not change color are often sold as so-called silver fish. One of the peculiarities of the different varieties of gold fish is that the older fishes change their color altogether from gold to silver, or vice versa, or develop markings of the different colors enumerated before. It is not satisfactorily explained, by what these changes, which in no way influence the health of the fishes, are caused. Different explanations, such as change of water, cli-
mate, food, or even injuries, have been given by different observers, but it may be well said that some of these solutions of the problem are more than doubtful.

In recent years large shipments of beautiful gold fish of different varieties have been received in San Francisco from China. The imports would be considerably larger, were they not connected with such enormous losses. While the fish usually arrive in San Francisco in fairly good condition, the receivers of overland shipments from San Francisco frequently suffer very heavy losses; as many as 75% sometimes perishing en route. This is not difficult to explain. The fishes arrive in San Francisco alive, but weakened by the long voyage from China, and, instead of being kept for a few weeks, in a large tank with generous feeding and good fresh water, that they may recuperate and become fit for the further journey, they are reshipped at once, and in their weak condition they are naturally unable to withstand
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the hardships of the long trip overland, aggravated by the carelessness of the transportation companies. The latter promise to renew the water in the cans containing the fish two or three times during the five or six days spent on the railroad, and while they are surprisingly prompt in collecting expressage for the fishes, dead or alive, they seldom live up to their side of the contract. The following varieties of gold fish are the most valuable for the amateur aquarist:

The Japanese Fringe-tail Gold Fish (*Carassius auratus*, var. *japonicus bicaudatus*), as also the Telescope fish, was introduced for the first time in Paris about 1870—being imported from China by Carbonnier. Besides its long scientific and common names, the Fringe-tail has to carry an abnormally developed caudal fin, the shape and size of which determine the market value of their owner. The body of a Fringe-tail should be short and compact. The tail should be vertically bifurcated and consist of two distinct
Fig. 51. Japanese Fringe-tail Gold Fish, Carassius auratus, var. japonicus bicaudatus.
halves, each ending in a graceful waving, drooping veil of a very delicate tissue. When in motion the tail should form a cloudlike mass with a well rounded outline. The anal and ventral fins should also be well developed, thereby adding to the beauty, grace and value of their possessor. Being the product of most careful and continual artificially controlled breeding, the differences in color, shape and size of this fish are numberless. It may be said that it is almost impossible to find two specimens exactly alike in every respect. While the Fringe-tail can be found in all colors in which the gold fish appears, a clear crimson is especially in demand. Fishes combining all the good points of this variety bring very high prices. Before purchasing one of these expensive fishes, the buyer should examine carefully the development of the dorsal fin. Sometimes the latter is crippled, marring the beauty of the fish and considerably decreasing its value. The Fringe-tail requires two
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three years to reach its full development and its greatest beauty.

The Fan-tail (*Carassius auratus, var. ovisformis*). The body of the Fan-tail is short and compact like that of the preceding variety; the principal difference between the two being in the caudal fin, which in this instance is double, but joined on the upper side, and standing rigid and fanlike from the body.

Fig. 52. Fan-tail Gold Fish, *Carassius auratus, var. ovisformis*. 
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In very good specimens the extreme ends are soft and wavy. The back should be strongly convex, fishes with a flat back-line being undesirable. Fan-tails in which the body has a more elongated and slender form are generally American bred, the imported fishes usually showing the egg-shaped body.

The Telescope Fish (Carassius auratus, var. macrophthalmus) gets its name from its abnormally protruding eyes. In good specimens the body should be very short and thick,—as nearly globular as possible. The tail, or caudal fin, is double and of medium length, while the anal fin is frequently missing. The value of the Telescope fish is less determined by the character of the different fins than by the size, shape and position of the eyes. The latter should be very large, far protruding and globular, or better still—cone shaped. Tubular eyes are frequent but are not considered as good as the other shapes. The eyes should also be of equal
size. If odd shaped they reduce the value of the fish. The direction of the eyes varies in different fishes, in some pointing sideways, in others forward to such an extent that they are in line with the mouth. In all fishes the eyes should be prominent, well-rounded and symmetrical. Telescope fishes with the fin formation of the Fringe-tail command very high prices, and are called Telescope Fringe-tails.

The Celestial Telescope Fish (*Carassius auratus*, var. *uranoscopus*) is the result of continuous artificial breeding with the development of one special organ in view. As in the previous fish the eyes are of abnormal size and form, but instead of being pointed forward or sideways, they are placed in such a position that they point straight upward. Of all the peculiar freaks produced by years of careful mating this is by far the strangest. The body of the Celestial Telescope fish is a short oval, like that of the former varieties. While the tail resembles that of the Fan-tail,
Fig. 54. Celestial Telescope Gold Fish, Carassius auratus car. uranoscopus.
the other fins show no abnormally strong development. Indeed in good specimens the dorsal fin is totally missing. This fish is the most unfortunate of the whole family. Unable to see in any other direction than upward it is practically helpless and unable to look for food except on the surface of the water.

So far most attempts to breed the Celestial Telescope fish either here or in Europe have failed, so that it is to China that we are indebted for all the fishes of this variety supplied to our markets. They come in all colors of the gold fish, but the highest priced specimens are of a uniform velvety black. The price of this fish, when of perfect shape and with all the essential points well developed, is almost prohibitive, except for the wealthy aquarist. Moreover, it is a very difficult fish to keep.

The Comet-tail Gold Fish (*Carassius auratus; var. japonicus simplex*) was introduced in this country about 1872. From its scien-
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tific name one might infer that this is a Japanese production, but some fanciers are inclined to consider it the result of Chinese breeding.

Fig. 55. Comet-tail Gold Fish, Carassius auratus, var. japonicus simplex.

The body of the Comet fish is not nearly as compact and clumsy as that of any of the other abnormally developed gold fish, but is
more slender, resembling in shape that of the common gold fish. The caudal fin is simple but very strongly developed, so that on fish two or three years old it hangs gracefully down, as is the case in the Fringe-tail. All the fins are large and delicate, and together with the tail surround the fish like a graceful undulating cloud. Many aquarists prefer a fine Comet tail to any of the other fancy varieties, not only on account of its graceful appearance, but because it is very hardy, easy to keep and to raise. Many of the Comet-tail fish sold here are bred in the United States. No fish is better fitted for the aquarium of the beginner.

All varieties of gold fish, as we have said before, come in different colors. Sometimes scaleless specimens of the different varieties are to be seen in the market. They are often beautifully colored and in great demand by such aquarists as are able to give them the necessary additional care; for they are more sensitive in regard to water than
the scaly fish, needing a higher temperature than the latter. It is remarkable that the young of the scaleless fish show their true color in the first few weeks of their life.

To be successful with all different varieties of gold fish they should either be kept by themselves, or together with only such fishes as are harmless and not aggressive.

The Green Tench (*Tinca vulgaris*) is an introduction from Europe, where it is frequently seen in aquariums, although as an aquarium fish it is of merit only so long as it is young.

The color of the young fish is a greenish
brown on the back, with faint, irregular markings of a darker color. The belly is of a bright silvery gray. A dark band separates the deeply forked caudal fin from the body. The head and eyes are rather large in proportion to the rest of the body, which, as long as the fish are young, has none of the heaviness of the full grown fish.

The young Tench is lively and graceful, and free from the sluggishness of the older members of the tribe. As it feeds mostly from the bottom, it is excellent as a scavenger in absorbing vegetable as well as animal

Fig. 57. Golden Tench, *Tinca chry-sitis*. 
refuse and such food remnants as sink to the bottom. It is peaceful and non-aggressive, and can be kept with all fish, except the strong carnivorous species.

The Golden Tench (*Tinca chrysitis*) resembles the above in shape and habits. Its

![Common Carp, Cyprinus carpio.](image)

Fig. 58. Common Carp, *Cyprinus carpio*.

color makes it one of the most attractive of aquarium fishes, its upper half being pale golden yellow, in contrast to which the large dark eyes appear very conspicuous. Below the lateral line, the color loses slightly in intensity, so that the lower part of the belly
The Inhabitants of the Aquarium is almost silvery white. Both Tenches are hardy and require little care.

The Common Carp (Cyprinus carpio) and its varieties are very desirable for the aquarium until they attain a large size. There is also the very interesting Mirror Carp, Cyprinus carpio cyprinorum, with the large, brightly colored scales placed in an irregular line on its sides. Both these varieties have been introduced into this country from Europe and by this time they are fully acclimated and sufficiently common to make it possible to secure them at a low price.
The Blue Carp and the Fire Carp are more recent introductions, coming from China, and are neither generally known nor easy to procure.

The Hi-goi or Fire Carp (*Cyprinus auratus*) is a quiet, peaceable fish, of good lasting qualities in the aquarium. The chief colors are a light golden yellow, a silvery white and a velvety black. While the silver color is always spread over the lower parts of the fish, the other two colors blend in such a way that it is impossible to find two individuals with similar markings. The Hi-goi will
The Inhabitants of the Aquarium 131 thrive well with the other members of the carp tribe.

The Carausche (*Carassius vulgaris*) is a hardy aquarium fish. By crossing it with its relative—the gold fish—beautiful hybrids have been obtained.

The Gold Orfe (*Leuciscus idus.*) is now imported from Germany and is a very hand-

![Fig. 61. Gold Orfe, *Leuciscus idus.*](image)

...some, hardy fish, combining the best qualities of the gold fish with a very lively disposition and a beautiful bright color, silvery below and bright golden on the back and sides. In its ways it is not unlike our own
well known and much liked Shiner and has the same long, slender shape, and graceful motions.

The Common Shiner (*Notropis cornutus*) is a lively fish of attractive shape and of quick, graceful movements. It is common in most of our easterly waters and thrives well in confinement. The color of the Shiner is steel blue on the back, silvery on the sides and abdomen, and beautifully glossy all over. The opercle has a golden luster. If placed in numbers in a vessel they will always keep together in little schools. Our illustration
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taken from life shows sharply defined black spots scattered all over the fish. While these spots appear in great numbers on some fishes, others are entirely free from them.

The Bitterling (*Rhodeus amarus*) is the smallest, but most interesting member of the carp tribe. It is imported from Europe and is a highly desirable acquisition for the aquarium.

This fish is most remarkable for its peculiar propagation. In spring and early summer, the male, usually bluish gray on the back and silvery white on the sides, prepares
for the mating time by changing these colors for a most gorgeous wedding dress of all shades of the rainbow, blended into a very beautiful ensemble. This coloring even affects the eye of the fish, where it manifests itself in a reddish tint. While the female fish retains its usual color, it develops, at spawning time, a pinkish ovipositor which hangs down to a length of about one inch. This organ, unusual in fishes, has a special function in the propagation of the bitterling. While it is not unusual for lower members of the animal kingdom or for fungi to require one or more hosts of a different family than their own, in order to reach a state of perfect development, it is indeed strange in beings so highly organized as fishes; yet such is here the case. The ovipositor serves for nothing less than to insert the eggs into the interior of a fresh water mussel,—*Unio*. To do this the fishes have to await the moment when the mussel opens to take in water, whereupon the female in-
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serts the ovipositor into the opening just long enough to drop one or two eggs. This operation is repeated until the mussel has its proper number of eggs, when a new victim is looked for. After the eggs are deposited, the male fish in turn hovers over the mussel until it opens, when he ejects the impregnating milk, which enters the mussel in the same manner as the eggs. The latter hatch in the gills of the mollusk and, after having occupied for about two weeks this part of the anatomy of their strange nurse or foster mother, the young fish leave it to shift for themselves in the open water.

The Mosaic Minnow (*Phoxinus laevis*) is, like the bitterling, an introduction from Europe, where on account of its peculiar markings it is called Mosaic or Zebra fish. It is one of our liveliest aquarium fishes and, with a sufficient amount of oxygen, will live fairly well in captivity. To see the minnows at their best they should be kept in numbers, when they hardly ever cease their
graceful play, chasing each other untiringly around stones and plants and very rarely resting on the bottom of their vessel. The Mosaic Minnow is a good scavenger, as it feeds on such food as other fishes may have dropped.

The Stone-biter or Blue Weather-fish (*Cobitis taenia*) resembles in shape and habit the former species, but is distinctly different in color and markings. Along the back against a light background appears a line of large, round, chocolate-brown spots, followed on each side by a row of smaller spots of the same color on a still lighter ground. A fine lateral line of dark brown separates the brown from a broad band of very light, al-
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most yellow color, which is followed by a line of round brown spots, larger near the head and decreasing in size towards the tail. The color of the belly is a grayish blue extending the full length of the fish.

Weather-fish (*Cobitis fossilis*) is a highly interesting fish with a long, slender, almost eel-like body. The dorsal fin is small and is placed nearly in the center of the back. All the other fins are small and round in outline. The head and the mouth are small, the latter being surrounded by a number of fleshy barbels. The small bead-like eyes are placed well forward and close to the mouth.
This fish is a study in different shades of brown, the back being of a warm olive brown, decreasing in intensity until, on the belly, it becomes a light orange. Above the lateral line runs a stripe of a lighter color, followed by a stripe of chocolate brown, which is again followed by a narrow light brown border separated from the orange of the belly by a slightly wavy dark stripe. The belly is finely mottled or spotted with brown. All the fins show dark brown rays on a nearly transparent glass-like ground. The caudal fin has bands of the same color alternating with others of an almost glassy transparency. The color and markings of the fish sometimes vary considerably. In some specimens we have found the markings to be of a fine light orange, the same color appearing also in the longitudinal bands. In spring the orange color of the male increases in intensity.

The mode of breathing of the Weatherfish is peculiar, in that it does not altogether
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depend upon the gills for the taking in of oxygen. The atmospheric air is taken in through the mouth, forced down into the intestinal canal, where the oxygen is extracted, the carbonic gas leaving the body through the anal opening in the form of large bubbles which mount to the surface of the water.

The Cobitis, when supplied with a sufficient amount of food, grows rapidly, even outgrowing the aquarium, where it is desirable only so long as it is of small size.

Preceding any sudden change in the weather, this fish exhibits great restlessness and activity, a fact especially noticeable, as it is usually sluggish and, if undisturbed, often rests motionless for hours. It is from this barometer-like disposition that it gets its name.

The Barbed Grundel (Cobitis barbatula) is somewhat more delicate than the other Cobitis. To keep it successfully the aquarium must be well stocked with oxygenating
aquatics. In general shape the Barbed Grundel resembles the previously described species. The upper jaw protrudes considerably and bears six barbels, four close to the nose and two near the joint of the upper and lower jaw. The scales are very small, only partly covering the body of the fish. The color of the back is dark greenish brown, frequently showing irregular markings of a dark brown, almost black color. The sides and the belly vary from gray to a yellowish gray. The ventral and anal fins are of a
The Inhabitants of the Aquarium uniformly pale yellowish shade, free from any markings, while the dorsal and pectoral fins show irregular black spots. A distinct black stripe runs between body and caudal fin.

The Common or White Sucker (*Cotostomus teres*), while it has not the bright color of many other fishes, deserves a place in the aquarium. The back varies from olive brown to brownish gray, growing lighter towards the sides, which are of a light slate color. Below the lateral line the sides are of a pale pink, as is also the belly. In spring this color changes to a bright, rosy pink. The almost round body tapers considerably toward the caudal fin, which is deeply forked. Under the influence of changing conditions these fishes vary somewhat in both shape and color.

The Sucker gets its common name from its habit of sucking in its food from the bottom with more force than is usually the custom of other fishes. It is a vegetarian
and can therefore be safely kept in the same tank with other harmless fishes.

**Stone Roller, Hog Molly, Crawl-on-the-Bottom** (*Cotostomus nigricans*). The color of the back of this species is olivaceous, marked with dark cross blotches, that of the sides being silvery white with a peculiar brassy luster, while the lower fins are red. As long as it remains small, this fish is desirable for the aquarium. It is found in streams from New York to Alabama.

**Cub Sucker, Sweet Sucker** (*Erimyzon succetta*). This fish is remarkable in the variations of its color, which run through different shades of a more or less dusky brown with black lateral bands or bars. The fins are of a dusky brown. It is found in all states from New York to Texas. When small it can be recommended for the aquarium.

In contrast to the previously named fishes which, being vegetarians, can be kept to-
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together in one aquarium without any detriment to each other, stand those which are carnivorous, aggressive and pugnacious. If not supplied with a generous amount of food, these fish will attack and devour smaller fish, even of their own kind. While such fishes may be placed together with the vegetarians, if the latter are of their own, or possibly of larger size, it is not without a certain risk, as they may damage fan-tail, telescope and similar fishes of slow and clumsy motion, by eating off their tails and fins. If the amateur wishes for the sake of observation, to place these fish together, he should watch them constantly, so as to prevent the destruction of valuable specimens. We have in America a number of the choicest varieties of native carnivorous fishes, comparing favorably with anything other countries are able to furnish.

The Common Sunfish, Bream or Pumpkin Seed (*Eupomotis aureus*) is one of the hardiest and most brightly colored of the carnivo-
rious fishes. Its back is of a rich olive color, the sides are bluish. During mating in spring the colors of the male fish gain considerably in intensity, the belly turning yellow, and a black and red spot appearing on the gills. In almost all the states of the Union this fish is to be found in ponds and such rivers as are connected with still water. It prefers water with a dense vegetation. As soon as spring weather begins to warm the water, the sunfish looks for a spot free from vegetation, sandy if possible, shallow, and near the shore. Here the male prepares the nest, which consists of a slight depression in which the female lays her eggs, which, after fertilization by the male, are guarded and protected against intruders by both parents. This otherwise very shy fish now changes its character entirely and becomes sufficiently bold to try to prevent even powerful enemies from approaching its nest.

After the eggs are hatched, both fishes, biting, and beating with the fins, violently at-
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tack any enemy that may attempt to disturb their brood. It has been observed that a male taken from the nest with a net, and replaced in the water about 100 feet away, returned to its post at the nest, before the

![Elongated Sunfish, Pomotis elongatis.](image)

observer was able to reach it. To ascertain to what extent this remarkable sense was developed, the same fish was caught again, carried half a mile away by one person, a second person watching the nest for the return of the fish. In about two minutes the
The Inhabitants of the Aquarium fish had completed the journey, a feat the more remarkable, as the pond was pretty well filled with vegetation. The courage and tenacity of this fish is most remarkable.

The Elongated Sunfish (*Pomotis elongatis*). The back of this fish is dark olive, while

![Striped Sunfish](image)

**Fig. 69.** Striped Sunfish, *Pomotis marginatus*. the sides are considerably lighter with dark vertical bars. Behind the dorsal fin a black spot is noticeable. The belly is yellow. Bluish lines mark the cheeks. This is a good fish for the aquarium, and is found in Florida and Georgia.
The Striped Sunfish (*Pomotis marginatus*), a native of Florida, is olive brown on the back and on the sides, and yellow below. Its sides are marked with vertical bars of brown, and on the head and sides are numerous bluish green spots. It is a remarkably satisfactory and durable aquarium fish.

*Bryttus fasciatus* is olive brown, with darker vertical bars, numerous crimson spots below and bright red eyes. This is a beautiful and lively little fish and well worth a place in the aquarium, but so far it is scarce.
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and difficult to obtain, although its native home is in Florida.

*Bryttus gloriosus* is of an olive brown color above, and yellowish white below. The fins are marked with numerous golden yel-

![Image of Bryttus gloriosus](image)

**Fig. 71.** *Bryttus gloriosus.*

low spots. One velvety black spot on each side near the root of the caudal fin, and one a little larger on the appendix of the opercle are its characteristic markings. It is very much to be regretted that this beautiful little fish is not seen more frequently in the aquarium. Although a fairly common fish
in Florida, it is difficult to secure it in commerce.

The Long-eared Sunfish (Lepomis auritus) is as hardy as it is beautiful, and can therefore be well recommended for the aqua-

![Image of Long-eared Sunfish](image)

Fig. 72. Long-eared Sunfish, Lepomis auritus, from the north.

rium. It is easily distinguished from other members of the family by its long and narrow ear flaps. The body is well proportioned and of a rather compact shape. Its ground color under superficial observation appears as a plain gray, but in a fairly intense light it has a beautiful metallic luster of different shades of mother-of-pearl blue.
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The upper two-thirds of the body are mottled with irregular olive-brown spots, dense above but decreasing in density toward the belly, leaving the latter completely free. The opercle on an olive-brown ground bears

![Fig. 73. Long-eared Sunfish, Lepomis auritus, from the south.](image)

two distinct longitudinal bars of a bright blue, the upper running to and ending at the eye, the lower extending to the nose. The belly of the male fish is light orange, changing, during the mating season, to a very intense orange red, the same color extending
in spots over the sides, where it appears on a blue background. The caudal fin varies in color from light brown to pale orange, with a colorless transparent edge. All other fins are nearly colorless and transparent, changing during mating time, in the male fish, to a pale orange. This handsome fish is found in rivers and ponds from Maine to Louisiana. With ordinary care it can be kept for years in an aquarium.

The Dusky Striped Sunfish (*Lepomis symmetrical*) is found, according to Jordan and Evermann, in the Mississippi valley and from Illinois to Louisiana and Texas. Mr. Eggeling has received specimens from New Orleans which were kept in captivity with very satisfactory results. While the fish has its good qualities, its coloring is not so rich and attractive as is that of other varieties of the same genus.

The Banded Sunfish (*Mesogonistius chatodon*). This fish is a general favorite with aquarists, and is found from New Jer-
sey to Maryland in sluggish waters with dense vegetation. When fairly well grown, its shape is almost disk-like. Dark, almost black stripes run from the back down towards the belly, growing lighter as they near the latter. The fins are very prettily marked. This is certainly one of the most attractive of aquarium fishes and will live very well if properly cared for. It needs a rather dense vegetation. Any sudden change in the temperature of the water is to be avoided, as it favors the parasitic fungi growths (Saprolegnies) which some-
times appear on the fish and which are very hard to destroy, eventually killing it.

The Speckled Sunfish (*Enneacanthus simulans*) is a beautiful little fish, found in slow running waters with dense vegetation. Its color is dark olive green with bluish blotches and spots of a mother of pearl-like appearance. On the male fish during mating time, these blotches and spots increase in intensity and together with the bright orange colored belly make it a very conspicuous and orna-
mental feature of the aquarium. On the female the mother of pearl spots along the sides are more regular than on the male and, although less intense, they are sufficiently pronounced to make even the female quite attractive. The Speckled Sunfish is found from New Jersey to North Carolina.

The Red-spotted Sunfish (*Enneacanthus obesus*) is in its general color not unlike the former variety; sides and back are dark olive, with the belly much lighter. Five to eight crossbars run from the back to the belly and the fins are irregularly spotted with gold and purple blotches. The Spotted Sunfish lives in slow running waters near the coast from Massachusetts to Florida.

Blue Sunfish, Coppernosed Bream, Dollardee (*Lepomis pallidus*). This is a valuable fish for the aquarium. The color is purplish or bluish silvery with greenish crossbars. In the older fishes the belly is copper colored, while the fins are red. The young are brighter and cleaner in coloring than the
older fish. This species is found in large lakes in New York, Kansas, Florida and Mexico.

The Round Sunfish, Flier or Peacockeye Sunfish \((Centrarchus macropterus)\) is an excellent inmate for the aquarium and is decidedly one of the most beautiful of all our fishes. While it is more common in the streams of such states as Virginia, Florida and Louisiana, it is also found as far north as southern Illinois. It is by no means a
common fish, which is to be regretted, as its qualities, its handsome color and its graceful and lively motions make it a very desirable aquarium fish. The body resembles in shape that of the common sunfish, being oval and rather narrow. The head is small, the snout short, the eye is large, showing a black line running vertically through the iris and the opercle, where it grows lighter and disappears near the lower part of the head. A number of broad dark bands extend from the back far below the lateral line and alternate with lighter bands of equal width. Under the changing light these bands show beautiful shades of greenish blue, with a soft, orange-colored border and irregular spots, the latter extending below the lateral line. The belly is of a bright yellowish silvery color with brown spots. All the fins are large and of delicate structure, showing pronounced markings in the shape of oval orange spots bordered with dark brown. In not all individuals are these markings
equally well developed; while some show them on all the fins, others have them only on the dorsal fin. Age and habitat may have something to do with these variations. The dorsal fin is very long, extending over nearly the whole length of the back. The young fish shows a very conspicuous oval black spot separated by a glassy border from a bright orange band, running nearly around the spot, leaving only an opening near the top. On the older fish nothing but the black spot remains.

Fig. 77. Rock Bass, Ambloplites rupestris.
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Rock Bass, Redeye, Goggle-eye (*Ambloplites rupestris*). This is a fish of olive green color with a brassy luster on the sides. The young fishes have black bars. The eyes are very large with the iris bright red. The rock bass will live well in the aquarium, but it should never be kept with weaker or smaller fishes, as it is very bold, aggressive and voracious.

Calico Bass, Grass Bass, Barfish (*Pomoxys sparoides*). This resembles the sunfish in
so many points that it is often mistaken for the latter. On a base of olive green with a silver luster, appear small irregular cross bars and marble like markings, forming a beautiful ensemble. The ventral and pectoral fins are placed rather high, and with their bright spots greatly increase the beauty of the fish.

It is considerably less aggressive than the rock bass, and if one or two years old is a very fine aquarium fish, although to thrive well it needs a dense vegetation. It occurs in the lowland streams and lakes, from New Jersey to Florida.

The Mud Minnow, Rockfish, or Dogfish (*Umbra limi*) is a small fish of some merit for the aquarium. Its color is dark olive green, mottled with a lighter shade of the same color and with pale, irregular, narrow bars. The colors vary in shade and intensity according to the locality where the fish is found. In the aquarium the Dogfish often stands rigid in an oblique direction,
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the head on the higher level, with only the pectoral and dorsal fins in rapid motion. It inhabits the waters of most of our easterly states.

![Mud Minnow, Umbra limi](image)

**Fig. 79.** Mud Minnow, *Umbra limi*.

The **Pirate Perch** (*Aphredoderus sayanus*) is a rare and interesting fish. As it is nocturnal in its habits it is difficult both to obtain and to observe. The body is compact, the head large and somewhat blunt, and the lower jaw protruding. The color of the
back is a soft, almost velvety olive brown, separated by a light yellow lateral line from that of the sides, which are of a slightly lighter shade of the same color as the back. The belly shows a broad, but not sharply defined stripe of a light yellowish brown, which in the male, gains in intensity during mating time. The frequent black points and markings mentioned by some authors are missing on some and barely perceptible on others of the specimens serving us for our description. The caudal fin is round in outline and shaded from a very light gray near the root, to deep black towards the edge, the latter being a narrow transparent and colorless band. The dorsal fin is almost as high as it is long and is placed at about an even distance between the nose and the caudal fin. All the fins are colorless and transparent.

The peculiarity that gives the fish its scientific name is that the vent or anal opening is placed close to the throat instead of
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The Inhabitants of the Aquarium near the anal fin. According to close observation the position of the vent changes with the age of the fish, being closest to the throat on full grown specimens.

The Pirate Perch is found in slow flowing streams along the Atlantic coast and in some of the western and southern states. It favors waters with dense vegetation in which it hides. It also uses the roots of trees or overhanging embankments for its haunts. While it remains almost motionless much of the time, it is very quick if disturbed, or if following its prey. Its movements then consist of a jerky shooting of lightning rapidity. It is very voracious and cannot be kept safely with smaller or slower fish. When mating time approaches male and female construct a nest, where they watch and defend first the eggs, and then the young until they are strong enough to take care of themselves. Full grown specimens reach the length of five inches.

The Black-nosed Dace (Rhinichtys atrona-
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*Rhinichthys atronanus* is an exceedingly graceful and lively little fish of a slender and well proportioned shape. Considering that this fish occurs mostly in clear, cold, rapid flowing mountain streams, it is rather surprising how well it stands the sudden change to the aquarium, with its radically different conditions. It can be transferred to the aquarium with less risk than some of the more brightly colored and larger fish of the mountain streams. While some of the fish may possibly perish during the first few days, the majority will survive and once acclimated, will probably live and thrive for years. If threatened, the fish will dart with lightning rapidity under stones, roots or into other

Fig. 80. Black-nosed Dace, *Rhinichthys atronanus.*
hiding places, but with a little skill and patience, enough to stock a medium-sized aquarium may be secured in a short while, provided a small net is used for their capture.

The coloring of this little fish is remarkable. The dark olive colored back is bounded by a bright, silvery band. Alongside and parallel with this, runs a very dark stripe which is continued over the nose, giving the fish its name. The belly is a beautiful silvery gray, which, in the male during mating time, changes to a bright orange red, extending also to all the abdominal fins. Occasionally males are found on which an orange luster overspreads the whole body.

The Long-nosed Dace (*Rhinichthys cataractae*) resembles in shape the above fish. The color is olivaceous, gradually shading to lighter towards the belly. The black band of the former fish is missing, but part of it may be found as a blackish spot on opercle and cheek. In spring during the mating season, the cheeks, lips and abdomi-
nal fins of the male fish change to a vivid crimson. The fish is found in rapid flowing streams.

**Eggeling's Dace** (*Rhinichthys gloriosus eggelingii*) is certainly the best colored of the daces and was first introduced from Florida by Mr. Eggeling. The color of the back is a rich glossy bronze-brown, bounded by a bright silvery stripe. Parallel with, and close to this, runs a band of the most beautiful dark shining blue. The belly is silvery. While the limited number secured of this handsome fish proved to be in every respect desirable for the aquarium, it has not been possible so far to bring large quantities into our state, as it is not a common fish even in its native waters and is difficult to transport long distances.

**Darters** (*Ethcostoma*). The different species of this fish are not as desirable as many others, but they are well worthy of being represented, as their peculiar motions (dart-
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ing) and their coloring make them sufficiently attractive to be an interesting addition to the aquarium of the amateur. After it is once acclimated the fish keeps well in the aquarium. It naturally prefers clear, shallow forest streams with a rapid flow and a clean stony bottom. If pursued it will hide under stones or bury itself in the sand. To keep the darter with success, the water in which it is placed should not be too deep. While it likes to stay near the bottom of the aquarium, it can also often be observed climbing among the aquatic plants, a pastime in which its pectoral fins are of great assistance. While all the many species of Etheostoma are attractively colored only the few following can be recommended for the aquarium.

The Rainbow Darter, or Soldierfish (*Etheostoma coerulea*) is the most richly colored of all the Darters. The back is olive green with darker blotches. Running from the back towards the belly, twelve stripes of an intense indigo blue alternate with stripes of
a bright orange color, forming a combination that can hardly be surpassed in beauty. The cheeks are blue, and the breast bright orange, while in the fins the two colors are combined.

Olmstead's Darter (*Etheostoma olmsteadii*) is of a rather dull olive brown with darker blotches of the same color. The sides and fins bear many light spots.

Spindle Darter (*Etheostoma fusiforme*) is dark olive, mottled with brown. Pale red spots are scattered all over the body.

*Fundulus* is a genus of from 40 to 45 more or less distinct species. Several have been introduced and successfully kept in our aquariums, so that they may be well recommended. The Fundulus are found all through the United States, but the most finely colored come from the south.

The Killifish, May Fish (*Fundulus majalis*) is the best known and the most common of its genus. The back of the male fish is
dark olive, the ground color of its sides and belly being a light salmon yellow. From twelve to eighteen narrow blackish bars run from the back down toward the belly. The lower fins are light yellow and the top of the head and the mouth are also yellowish. The back of the female fish is a light olive color decreasing in intensity toward the belly. A narrow black stripe runs all along each side and two shorter stripes run under the long one. Two short black bars cross the upper longitudinal stripe near the base of the caudal fin. This Fundulus is found from Cape Cod to Florida.

The Fresh-water Killi (*Fundulus diaphanus*). Its color above is olivaceous, the sides bright silvery white. The male has about twenty silvery vertical bars interspaced with a darker color. The female fish has usually sixteen bars, but they are somewhat shorter than those of the male, and slightly paler in hue. The young Killis show these markings quite distinctly
Fresh Water Aquarium

and always in black. This fish is very abundant in our waters and can easily be procured in any number.

The Broad Killifish (*Cyprinodon variegatus*) is a very lively, and graceful fish. In spring it leaves the brackish water to swim up the fresh water streams, where it can easily be secured in large numbers. When full grown it is barely three inches long. The color of the male Killi is dark steel blue with faint traces of cross bars, and during the mating season the usually grayish-white belly becomes a coppery red. The female fish is of an olivaceous color above, the sides are silvery with blackish cross bars.

It is very much to be regretted that this attractive fish is so difficult to keep in the fresh water aquarium. Even if caught in fresh water streams, it will not live long in confinement, but it can be well recommended for the salt water aquarium. Unscrupulous or ignorant dealers offer the Killi under different names to inexperienced amateurs,
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who, tempted by the attractive appearance of the fish, buy it, only to see it perish after a short time.

The Holbrook Gambuse (Gambusia affinis). This very handsome little fish should be bet-

![Fig. 81. Holbrook's Gambuse, Gambusia affinis.](image_url)

ter known. It is one of the oddest of our aquarium fishes, not only on account of its coloring, and the difference between the sexes, but also because, instead of spawning like most other fishes, the young are born in their perfect form. The male is
rarely seen, very small and so different in its coloring and markings from other aquarium fishes, that it deserves special attention. On a clear silvery ground many irregular velvety black spots and blotches appear sharply defined. On some specimens the caudal part is all black. The dorsal fin is nearer to the tail than to the head and is about as high as the body, the caudal fin is large and fan-shaped, and both are black near their base. The ventral fin is long and slender, about one-third as long as the whole body. The female is much larger than the male and so different in color, that the casual observer would certainly take it for an entirely different fish. Its color is a very light olive with faint markings of a darker color. The dorsal and caudal fins are shaped like those of the male and show several lines of dark dots on a light ground. The ventral fin has the usual broad and short form. This fish is
The Inhabitants of the Aquarium found in the southern United States, and with ordinary care lives well in the aquarium.

The Yellow Stone Catfish (*Noturus flavus*) has a yellowish brown or blackish back and is lighter below. The fins have a yellow border, the head is rather broad and flat, and the body is of an almost cylindrical shape, compressed towards the tail. The mouth is wide and carries a number of short barbels. As long as the *Noturus* is small it can be recommended for the aquarium, as it will not then attack other fishes. It is found in great numbers from Vermont to Virginia.

The Tadpole Stone Catfish (*Noturus gyrinurus*) is pale yellowish brown. The body is comparatively short and thick, but the head is long. It has long thick spines in the dorsal and pectoral fins. This is a fish of some value for the aquarium. Its full length is
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about five inches and it occurs commonly in ponds from New York to the upper lake regions.

The Black-headed Catfish (*Noturus miurus*) is gray mottled with black, the top of the head and the fins are dark, almost blackish. It will never grow longer than four inches. This is a common fish in ponds and lakes from Minnesota to Louisiana.

The Bullhead, Horned Pout, or Black Catfish (*Amiurus catus*) is of a dark yellowish brown color which often varies to almost black. This is a common fish in the streams of the north and east and, if small, is well adapted for the aquarium.

The Black Catfish (*Amiurus crebennus*), as its name indicates, is very dark, almost black on the back, the belly is of a lighter yellowish tint, and the barbels and fins are black. The body is rather long and slender, and somewhat compressed; the head is long. The dorsal fin is of unusual height, with a long spine, and the pectoral spines are also very
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long. Like the others of its family, it thrives well in the aquarium. The Black Catfish is found in rivers, ponds and ditches in Florida.

The White, or Channel Catfish (Ictalurus albidus), is of a pale olive color turning to bluish silvery below. The body is slender and slightly compressed. The head is of a conical shape and longer than wide, with a narrow mouth surrounded by barbels. The upper jaw projects considerably over the lower. It is found in ponds and rivers between Pennsylvania and North Carolina.

The Spotted Catfish (Pimelodus maculatus) is of rather compact shape in comparison with other species of its family. The head is long and very rough to the touch. Fleshy, threadlike organs (barbels) placed around the mouth are a characteristic of the whole catfish family. Those on the upper lip of the Spotted Catfish are very long and two in number; those on the lower lip, four in number, are very much shorter. The color of this fish is a clear grayish brown, changing
to white on the belly. Four longitudinal rows of dark brown spots on the body and blotches on the body and fins distinguish this fish from other closely related species. The dorsal, as well as the two pectoral fins, contain one sharp strong spine outside of the usual number of soft rays. In the aquarium this fish thrives well, if the water is kept moderately warm.

The Common or Longjawed Catfish (*Amiurus vulgaris*), is as interesting a fish as it is hardy and modest in its requirements. The color is of the darkest olive brown, almost black on the back, and, passing gradually through different shades, changes to a much lighter color on the belly. Its eyes are enlivened by a circle of the brightest gold color. It has two long barbels on the upper, and four shorter on the lower lip. While the catfish is fond of hiding among dense vegetation, it will often, and for hours at a time, venture out of its shelter and indulge in lively play and graceful sport.
The Spotted Mailed Catfish (*Callichthys punctatus*) is a native of Brazil, from which country it was introduced by Mr. Eggeling. It is one of the oddest and most interesting of fishes. Its head and body are protected by large strong scales, overlapping each other in shingle fashion. Of these scales each side has two rows. The barbels, four in number, are rather short. As is the case in the other catfish, the dorsal and pectoral fins contain one strong thorn each. The color on the upper part of the head and body is a glossy olive green, changing to light yel-
low on the belly. The sides are marked with several longitudinal rows of dark spots, and four black cross bars, while a black spot marks the base of the caudal fin, which is yellowish in color. The dorsal and anal fins each have a black cross bar on light ground. The eyes are golden yellow.

Most remarkable is the process of mating of the Mailed Catfish. By approaching the ventral fins towards each other the female forms a kind of a pocket into which the male ejects the fertilizing fluid. After this is done the eggs enter the same pocket, to be placed a little later on stones, leaves or other bodies of a suitable shape and substance. This fish will thrive well in the aquarium and, as it is one of the less voracious of the tribe, may be kept with other weaker fishes, if a sufficient amount of food is provided.

The Blue Mottled Catfish (*Pimelodus marginatus*) is one of the most brilliantly colored of the family, dark blue on the back, changing to a lighter color on the sides and
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to white below. It is marked with dark spots and blotches all along the sides, while the fins show dark markings near their root. The mouth is surrounded by eight barbels. The Pimelodus is found in Florida, Georgia

![Fig. 83. Blue Mottled Catfish, Pimelodus marginatus.](image)

and possibly in some other of the Southern States.

Mr. Eggeling has kept the Pimelodus very successfully. It is a fish of quiet, peaceful disposition, and is highly ornamental in the aquarium, but it is so far rather rare and difficult to obtain.

The Slender Catfish (Pimelodus gracilis)
Fig. 84. Slender Catfish, Pinelophus gracilis.
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fully deserves its name, as its body is longer and thinner in proportion, than that of any of the other catfish. The head is long and pointed and bears on the upper lip two barbels of about half the length of the body. The four barbels on the lower lip, if folded back, would reach the pectoral fins. The dorsal fin is very high, and the caudal fin is strongly bifurcated. The color of this graceful fish is light brown above and a yellowish white below. Two, sometimes three, dark stripes run from the head toward, but not quite down to the tail. This fish was introduced from South America and will keep well in the aquarium, not requiring any more care than the previously named catfish.

Striped Catfish (*Macronis vittatus*). This is a recent introduction from the East Indies and so far rather rare in this country. It is a slender, graceful fish, lively and rapid in its movements. The fins are glassy transparent and shaded with a very light gray. The caudal fin is bifurcated. Four stripes
varying on different individuals from a blackish gray to light flesh color or grayish red run along each side of the body. They alternate with light yellow lines, of which the middle one shows a bluish mother of pearl luster. The mouth bears eight bar-

![Striped Catfish, Macronis vittatus.](image)

bels, the second pair of which is fully two-thirds the length of the body. The eyes are fairly large, protruding and placed near the nose. Just back of the opercle our specimens show a velvety black, oval spot. We have had no opportunity to observe if this is char-
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cacteristic of both sexes, or not. This handsome fish is hardy and lives well in the aquarium, where it can be kept together with other fishes. It will thrive on any of the fish-foods recommended in a later chapter.

The Schinggi (*Saccobranchus fossilis*) is imported from the East Indies, where it is one of the food fishes. In shape it resembles the other catfish. The dorsal fin is very small, the caudal fin small and round, while the wide anal fin extends over nearly two-thirds of the length of the belly. The color of the Schinggi is a dark olive green with a faint bluish luster on the lower parts. Some specimens show irregular fine black dots all over the body and two faint yellowish parallel stripes along the sides. The lower part of the anal fin is of a darker color than the rest. The long barbels are very dark, almost blackish green, and the eyes are bluish with a golden circle around the pupil. Even when young, the fish may spawn if kept in a large tank. It is hardy and com-
Fig. 86. *Schizothorax fossilius*.
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pares favorably with other members of the same family.

It may not be generally known that all catfish carry in their fins, either the dorsal or pectoral, sharp spines which are not always very noticeable. By careless handling these spines frequently enter the tender parts of the hand, and while the injury is in no way dangerous, it is exceedingly painful, the pain lasting for several hours. Larger fishes are often tempted to attack and swallow the catfish, a process made almost impossible by these spines and frequently resulting in the death of the aggressor.

Few fishes introduced from foreign countries for aquarium use have given more satisfaction and pleasure than The Paradise Fish (*Macropodes viridi-auratus*). Brilliant, with colors only comparable to those of the beautiful tropical butterflies, as hardy as any of our own native aquarium fish, willing to mate and to spawn in the most primitive sur-
roundings, the Paradise Fish cannot be surpassed in value for the aquarium by any other fish. The color of the Paradise Fish is subject to many variations and changes caused by local conditions, such as differences in light and temperature, or by excitement, or by the approach of the mating season. On a ground color of a more or less intense bluish green appear vertical bars of bright orange. The head and the adjoining parts of the back are dark, silver gray with large dark irregular spots. The
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large fins are orange in color with a bright blue border. The pectoral fins are an exception, appearing as two threads of the most intense orange red. The male fish can easily be recognized, as not only the colors are considerably more intense, but the fins are also stronger and larger. A never failing distinction between the sexes is a large orange-bordered spot of the darkest blue on the cheek of the male, even young male fish having this spot, which, on the female, appears only very faintly, if at all.

In a later chapter the mating and nesting of this most interesting little fish is described.

The Macropodes thrive best in water which has been kept in a tank for some time. Even in partly renewing the supply, entirely fresh water should be avoided.

The Gourami (Osphromenus olfax) is a very beautiful fish, comparing favorably with the Macropodes. In 1902 Mr. Eggeling imported the first Gourami direct from Calcutta. In shape it is not unlike the Mac-
ropodes. Very remarkable are two threads running the full length of the body of the fish. They are the extensions of the first rays of the ventral fins.

In its habits also the Gourami very much resembles the Macropodes. It constructs a nest and takes care of the young fishes. It is of a rather quiet disposition and as its nourishment is to a large extent vegetable, it is less dangerous to smaller fishes than
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are the Macropodes. During mating time it surpasses the Macropodes in the beauty and richness of its wedding dress. The dominating color of its nuptial garb is a warm reddish brown with a bronze luster. From seven to nine oblique cross bars of a dark metallic bluish green are spread along each side, forming a very fine contrast with the darker color. The belly is bright silver colored with brown dots and rings. The two ventral threads are orange red, the dorsal, anal and caudal fins are steel blue with white and orange borders, while the pectoral fins have a velvety black eye spot. The eyes are red or golden yellow. During the winter the whole coloring of the fish fades to such an extent, that the stripes and other markings are barely perceptible.

To be successful with the Gourami, the aquarium should be well provided with vegetation and the temperature of the water should not be too low. As soon as the temperature sinks lower than is good for the
fish it will give warning of the fact by losing its liveliness and colors. Otherwise it requires hardly more care and attention than the common gold fish.

**Dotted or Spined Gourami** (*Osphromenus trichopterus*) differs from the Gourami in its color, which is olive. The sides of body and head have dark brown cross bars. Very characteristic are four round, sharply defined spots of a velvety black, one pair of which is placed on the sides about midway between the head and tail, the second pair on the base of the caudal fin. The dorsal and caudal fins have a light border. During mating time the colors increase greatly in intensity and sharpness of outline.

*Osphromenus trichopterus*, var. *cantoris*, frequently considered a variety, differs from the former, in that the black side spots are missing. A dark band with a light border runs in a zigzag line from head to caudal fin, the latter having white blotches. The color
The Inhabitants of the Aquarium of the pectoral threads is grayish yellow.

**Climbing Perch** (*Anabas scandens*). This peculiar fish, which was imported from Calcutta by Mr. Eggeling in 1903, is able to live outside the water for hours at a time. While other fishes may also be able to do this, the Climbing Perch is one of the very few, which, under certain conditions, leave one place to travel for great distances overland. The gills and fins are provided with sharp teeth, which the fish uses with great
skill and success to propel himself on dry ground. Whenever the sun evaporates the body of water in which the fish live, to such an extent, that it is no longer sufficient to offer them a safe home, they emigrate in masses to other waters, or if these should not be found in good time, they bury themselves in places sufficiently moist to keep them alive, until a rain makes further progress possible. A special organ called the labyrinth, enables the climbing perch to breathe outside the water and to carry a certain reserve supply of water for cases of emergency. The old, and even now not altogether forgotten belief, that this fish was able to climb high trees, has long been exploded by the careful observation of reliable scientists.

The color of the Climbing Perch is not as gaudy as that of many other fishes, but it is sufficiently attractive to make it a desirable acquisition for the aquarium. This fish is brownish olive green on the back and light
yellowish gray below and often has from eight to ten dark cross bars. Behind the operculum is a roundish black spot and on top of the head another of light rust-brown color and oval shape. The pectoral fins are orange-colored and the dorsal fin brownish. The eyes are of a golden yellow. While the coloring is changeable and of different intensity according to outside conditions, the males are, as a rule, darker than the females and their colors are more sharply defined.

The Anabas is found in the shallow and stagnant waters of Ceylon and the East Indies. It lives well in the aquarium and requires no extra care. Shy in the beginning, it will hide behind stones or among the plants, but it soon familiarizes itself with its surroundings and becomes very tame. As the fish frequently tries to jump out of the water, it is safer to cover the aquarium with a wire netting.

The Snakehead Fish (*Ophioccephalus punctata*)
Fresh Water Aquarium

*tilapia*, like the above, was introduced by Mr. Eggeling from the East Indies, and is a very interesting and handsome addition to our aquarium pets. Lively and very quick and sudden in its actions, hiding in the densest vegetation as soon as anything strange or unusual appears, and then peeping out with its bright eyes, it is an interesting subject for close observation and study.

The body is graceful and slender, the ventral and anal fins are grown together, the head is rather small and about one-fifth of the length of the body. It is the shape of the head that gives its owner the name—Snakehead Fish. This fish is a glossy greenish blue on the back, yellowish blue on the sides, while the belly is pearl white, slightly tinged with blue and profusely dotted with black. Each side bears a number of alternating dark and light ribbon-like cross bars. The fins have a light border. The eyes are black with a golden red or yellow iris.
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An interesting peculiarity of the Snakehead is the fact that it changes color under the influence of excitement of any description. This hardy and easily cared for fish well deserves a place in our aquarium, although, being so voracious and pugnacious as to attack everything in sight, it should not be kept with smaller fishes.

**Striped Snakehead** (*Ophiocephalus striatus*). While this and the previous species are alike in shape and in certain other points, they differ in color; the back of the striped Snakehead being brownish gray or brownish green, with prominent cross bars running down toward the white belly. The dorsal and anal fins bear numerous white dots. Around the black pupil of its very beautiful eyes runs an orange-red stripe, bordered with a white circle. This fish, like the former, changes its color under excitement.

**The Fighter, or Battle Fish** (*Betta pugnax*), is a native of the waters of the East Indies, Siam and the Sunda Islands and is a rather
small fish, not unlike our three-spined stickleback. In water of a low temperature the color is a dull, grayish yellow, but in a higher and more suitable temperature the coloring is remarkably beautiful and can compare favorably with that of almost any other aquarium fish.

The ground color of this fish is a warm reddish brown, with blood red, dark blue and green stripes running from the back toward the light-colored belly. The rays in the dorsal and caudal fins are greenish blue with a red border. The operculum bears a red and a deep blue spot. The ventral fins are bluish white, the caudal fin is greenish blue with an orange-red border, and the anal fin red with silvery gray. The eyes are mother of pearl colored.

Hardly two inches long, this little fish is a bold, fearless fighter, so much so that the inhabitants of their native islands keep them in vessels in order to observe their battles at close range. If excited, the fish will
spread its gills so that they appear like a collar. The Betta builds a nest and takes care of its young in a manner not unlike the Macropodes.

The Shooter (*Toxotes jaculator*) is one of the strangest fishes known to the naturalist. It is a native of Java, where the inhabitants keep it in their rooms, or in small ponds in the gardens. When full grown it is from six to seven inches long. The color of its back is a dark greenish gray turning to a silvery gray toward the belly. Each side bears four black cross bars, broader above and running to a point below. The anal fin is yellow with a black seam. The iris is light yellow. The first five rays in the dorsal fin are developed into long but not disconnected spines.

As soon as the Shooter sees an insect, it approaches to a distance of from one to four feet, and from its mouth ejects a few drops of water with so true an aim, that it seldom fails to bring its quarry down into the water.
Should it miss the first time, it swims around the vessel until it finds itself again opposite the insect, when the attack is renewed. Travelers found this fish in Japan about the middle of the last century and reported that it was kept in tanks and little ponds with a stick in the center. On this stick insects were fastened with a thorn and before long the fish would make an attack upon them, as described above. Brehm confirms these reports in his beautiful book “The Fishes.”

The Chanchito (*Heros fasciatus*), a native of South America, is found in ponds and slowly flowing streams and rivers in the watershed of the La Plata river. Very easily cared for, satisfied with a small aquarium, it is a good fish for the amateur aquarist, never failing unless the water should be kept too cold. While in cool water its coloring is not brilliant, it is very beautiful in a higher temperature.

In shape it is a rather compact fish, of medium length, with a strongly convex back.
Its ground color is glossy green or yellow, with velvety black cross bars running from the back to the belly, extending also over the strongly developed dorsal and anal fins. The four last stripes are marked by a glossy black spot on each. The caudal and pec-

toral fins are black. The eyes are yellow, or greenish-yellow, changing during mating time to a rich blood red. At this time also the entire coloration of the fish increases in intensity and beauty. Until it is full grown, its color continues to improve.
The Chanchito needs a sandy bottom and fairly dense planting in order that it may thrive well and mate, thus giving its owner a chance to observe the very interesting manner in which it proceeds to prepare for this important event and in which it cares for its young. The fish first prepare shallow depressions in the sand. Then the male pushes the female towards the hollow, using often more force than is necessary, biting or tearing her fins and body. After the spawning, and the recovery from the exhaustion following this process, the fish take turns in guarding the nest against intruders. Both sexes by a rapid waving of the fins create a circulation, thereby supplying fresh water and oxygen to the spawn. Soon the young fish appear, and are closely watched by the parents. The whole family swims about together, the old fishes leading, always returning again to the original nest until the young are strong enough to take care of themselves. The Chanchito is very aggres-
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sive and cannot be kept with smaller fish of quiet, peaceful dispositions.

The Common, Three-spined, or Nest Building Stickleback (*Gasterosteus aculeatus*), is one of our most interesting little fishes. As

![Three-spined Stickleback](image)

Fig. 91. Three-spined Stickleback, *Gasterosteus aculeatus*.

soon as spring comes and the ice disappears from the streams and rivers emptying into the sea, the Stickleback swims inland, following up these watercourses. It frequently takes advantage of the tide, allowing itself to be carried into the swamps, where, in the deeper places, it remains to spawn.

The color of the Stickleback varies
greatly; in some it is dark greenish brown, in others bluish black on the back, changing to silvery white on the belly. Throat and breast have a pink tinge, turning, in the case of the male during mating time, to a very vivid red, which extends over the larger part of the belly. The eyes are of a greenish color. Characteristic, and responsible for the name—Three-spined Stickleback—are three sharp thorns which take the place of the forepart of the dorsal fin.

Placed in the aquarium in March, a pair of these fishes will soon begin to make preparations for the spawning. To facilitate this a fairly dense vegetation should be provided. The male selects a fitting place for the nest, usually in a cluster of aquatics near the bottom. He then carries to the nest site fine roots and parts of plants which he has torn off for the purpose of constructing the nest, which he now proceeds to do in a very neat and ingenious way. To prevent the nest from being removed he secures the
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stems holding it, by an extra quantity of gravel, which he carries to the spot in his mouth. In about two days the little globular nest is finished, the openings, serving for entrance and exit and facing each other, have been made and now begins the spawning process.

The male by pushing and playing coaxes the female fish into the nest where the eggs are deposited; this done the male fertilizes the spawn and keeps a careful and indefatigable watch over the nest and its precious contents. If one desires to keep the female alive, she should now be removed from the aquarium; otherwise the male will certainly kill her. Nothing is allowed to come near the nest and even much stronger and larger fish than the Stickleback are attacked with blind fury and driven away in the most persistent manner. To secure fresh water and a sufficient amount of oxygen for the eggs the male will take up a position in front of one of the openings and, by a rapid
and energetic waving of the fins, cause a current of water to pass through the nest and over its contents.

After about two weeks the young appear, but even now the care of the male does not end. If some of the helpless little fish escape, or tumble from the nest, he will carefully gather them in his mouth and bring them back to safety. As soon as the young are strong enough to leave the nest and shift for themselves, the male should be removed, as it may happen that he will feed on his own offspring. The latter in the first few days will exist on the infusorians found on the plants. Later a few drops of meat juice may be given, to be followed, after the fish are stronger, by meat very finely scraped or by an artificial fish food, of which we speak in the chapter on the feeding of the inmates of the aquarium. No matter what the food, it should be given sparingly, so that nothing remains unabsorbed to pollute the water.
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The Stickleback is an excellent aquarium fish and will give great satisfaction and pleasure to the amateur aquarist. It is not advisable to keep it with weaker fish of a quiet disposition, as it is a born fighter, aggressive and fearless.

The Nine-spined, or Common Eastern Stickleback (*Gasterosteus pungitius*), is dark olive above with dark irregular cross-bars, and silvery white belly. During mating time and in summer, the silvery color on the belly often becomes a deep black. This fish is smaller than the Three-spined, which it otherwise resembles in most essential points. It is common in both salt and fresh water in streams and swamps along the Atlantic coast.

The Brook Stickleback (*Gasterosteus incomplete*) differs in color from the others. During mating time the male is jet black, with red on the forepart of the body. The female and the young are of an olive color, mottled and dotted with black. The num-
ber of spines on the back is four. In its habits this fish is like the other species of its family. It is found in fresh waters from New York to Kansas.

The Banded, or Trout Pickerel (*Esox americanus*), has the long slender body of the pike tribe and is a hardy and robust fish. The back is dark green, the belly silvery gray, while the sides are marked with numerous dark stripes, alternating with stripes of a light silvery green color. The eye is rather large and traversed by a black stripe running from the opercle to the mouth, and another black bar is below the eye. If small enough, that is from two to four inches long, this pickerel is a very good fish for the aquarium, but as it is of voracious temperament, it should be kept either by itself, or with fish of larger size. Fully grown it measures about 12 inches. It will often remain motionless, in some place in the aquarium favorable for observation, watching for the approach of prey, usually
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Fig. 92. Banded Pickerel, Esox americanus.
in the form of an unfortunate little fish, which with the rapidity of lightning is attacked, seized and devoured. This pickerel occurs in ditches and streams from New York to Florida.

**The Green Pike, Chain Pickerel, Common Eastern Pickerel** (*Esox reticulatus*). The color of this fish varies considerably, according to the locality where it is found. The back is a shade of green. A golden luster spreads over the same color along the sides. The fins are of a uniform pearl gray. A dark band runs below the eye. The whole fish, a narrow stripe along the belly excepted, is covered with an irregular network, or chain-like design of a darker shade of the ground color. This gives the fish its common name,—The Chain Pickerel.

This is an interesting fish but too voracious to live at peace in the same vessel with smaller specimens. It is found from New York to Florida.

**The Little Pickerel** (*Esox salmoncus*) has
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Fig. 93. Common Eastern Pickerel, *Esox reticulatus*. 

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the usual shape of the pike, but very large eyes. It resembles the others in all essential points. The color is green, becoming light on the belly. The sides are marked with numerous curved streaks, often taking the form of bars. A pronounced black bar runs below the eye. The fins are of a uniform grayish color. It lives in streams in the South and West, where it is quite common.

The Muskellunge, or Muscallonge (*Esox mas-quinongy*), may be kept in the aquarium as long as it is very small, but even then only with fishes of at least its own size. Aquarium specimens are long and slender, the back slightly convex and the line of the lower side parallel with that of the back. In general shape it resembles the pike, which it surpasses in size when fully developed. The color on the back is a dark gray with a silvery luster, and silvery white on the belly. Numerous dots and stripes of a blackish and dark brown color are distrib-
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uted over the whole body, the extreme lower or abdominal part excepted. The fins are prettily striped with short black lines. This fish occurs in the Great Lake section of the United States and Canada, and in the St. Lawrence river.

The American Perch (*Perca americana*) is, on account of its habits, a fit companion for the pickerel, being just as voracious and aggressive as the latter. The back is dark olive green, the sides yellow with six to eight dark cross-bars, and the belly pale yellowish gray. The orange red of the lower fins gives an attractive touch of brilliant color. As long as it is small, this fish
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may be used for the aquarium where, on account of its quick, graceful movements, it will be found very interesting. This perch is very abundant in the Eastern States where it is found in almost all ponds of fresh water.

The Mudfish, Bowfish, Grindle, John A. Grindle (*Amia calva*) is a rather slender fish, with a body nearly as broad as it is high. The dorsal fin extends over about three-fifths of the back, its outer line running par-
allel with the upper line of the body. The pectoral and ventral fins are small and well rounded in their outlines, as is also the anal fin, while the caudal fin is undivided and fan-shaped. Where the dorsal and the caudal fins meet, the male fish has a round velvety black spot, surrounded by a circle of light gray. The color of the Mudfish is a dark olive brown above, with fairly distinct markings of a lighter color along the sides. The lower part is considerably lighter, and of a silvery gray color, while the fins are dark with lighter markings, varying in shape and distinctness.

This hardy and interesting fish is found in most parts of the United States. As it is voracious it should not be kept with smaller fishes. The Amia is one of the few lungfish in the United States. It comes to the surface of the water to inhale air, as can easily be observed, even in the youngest specimens.

*Dormitator maculatus*. This handsome
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fish is found in fresh and brackish waters on the shores of the Pacific and Atlantic oceans, in Central America and the West Indies.

Fig. 97. Dormitator maculatus.

The body is compact, the head rather small and flat on top, with the medium-sized eyes placed near the nose and very close to the top of the head. The lower lip is somewhat
protruding. All fins are of fairly good size and rounded in outline. The caudal fin is fan-shaped and undivided. The color of the fish varies from a dark blackish brown to a lighter olive brown, relieved by lighter spots of a bluish tint. A faint dark stripe, on some specimens separated into spots, runs along the sides. A large black spot with a blue center is conspicuous on the base of the pectoral fin, but appears only on fishes of a certain age, being faintly indicated, or altogether missing on small specimens. Some fishes show a distinct dark band between the pectoral and the base of the caudal fin. The head has two blackish stripes on each side. All fins show dark blotches on a glassy ground, in the anal fin these blotches taking the form of length bars.

As an aquarium fish the Dormitator can be recommended as a lively and graceful inmate which is also exemplary in its behavior to other fishes. If well fed, it will soon outgrow a small aquarium.
The Eel (*Anguilla rostrata*) is found in all waters close to, and connected with the coast. Occasionally and when small, it is kept in the aquarium, where it will live for years. Caught young and during the winter season, it is silvery white and almost transparent, the eyes appearing like two small black beads in a silvery setting. Exposed to the light the color gradually darkens, until it is of a rusty brown or a light olive green above and yellowish below. It is not safe to keep the eel with non-aggressive or slow-swimming fish. It is especially risky to keep it together with long-finned and long-tailed gold fish; for it will fasten itself to some part of the fins, taking such a tenacious hold that it only drops off when the piece enclosed between its strong jaws separates from the body of its victim. Fish of quick motion but little strength know how to avoid this very interesting, but bold and aggressive robber.
REPTILES.

The reptiles form one of the most interesting classes of the animal kingdom, where they occupy a distinctly separate position. Like other of the higher organized animals, they breathe through lungs, without undergoing the metamorphosis to which the Amphibians are subject. Reptiles are cold-blooded and are covered with bony and horny plates, or scales. While many orders are extinct, several are still living, of which only two are of interest to the aquarist,—the turtles and the lizards. Their propagation is by eggs. In some species the latter are kept within the body until the young are fully developed so that they are born in the form of the parents, in others the eggs leave the body of the parent with the young only partly formed, in which case the sun completes the hatching process. Most reptiles hibernate in a state of deep sleep, close to inanimateness.
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The Turtles, *Testudinata*, interest us especially as inhabitants for larger aquariums. Their most peculiar characteristic is that they carry their bones, or by far the greater part of them, on the outside of their bodies. They are transformed into a case consisting of an upper shell, the carapace, and a lower shell, the plastron. In some turtles the two are joined by a strong bony connecting piece, so that they are absolutely rigid; in others, part of the soft body separates the two shells, in which case the plastron is movable so that the animal can draw it up close to the carapace, hiding completely between the two. There is still a third arrangement in which the plastron is divided in two parts, so that it can be drawn up, both in front and in the rear, enclosing all parts of the turtle within its protecting confines. The bony shell has a horny covering which in some species bears markings of different colors.

The eggs of the turtle are round and have
a firm white shell almost like that of a bird's egg. They are usually laid in considerable numbers, in sandy places exposed to the sun. After a few months the young turtles leave the eggs and, if water turtles, go into the water at once; if, however, they are land turtles, they look for a place on dry land, where they can hide under plants, roots, rocks or in small cavities in the ground. While the sexes show very little or no distinction from each other, it is quite easy to recognize the male turtle by a pronounced depression in the plastron, about one-third of its length from the head. During the mating, this depression fits upon the carapace of the female.

In this volume we describe only such species as will be useful for the aquarist,—that is, the water turtles. To keep turtles successfully, provision should be made to enable them to leave the water when they please. While a free floating piece of cork may answer the purpose, a miniature rock
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rising above the surface of the water is preferable. Most turtles become so tame that after a while they take food from a little stick, or even from the hand. All turtles should be placed in aquariums when quite small. They grow very slowly and can be kept for many years, before their size makes them unfit for confinement in a small vessel.

The Painted, or Mud Turtle (Chrysemis picta), is the best known and the most common of all our water or swamp turtles. The carapace is rather flat and on young specimens has a strongly pronounced ridge running from head to tail through the middle of the shell, which is of a greenish black color. It is surrounded by a border of small, so-called marginal plates. These bear bright scarlet markings of a triangular shape, so placed that the point of the triangle is directed toward the inside. The under margin of the carapace has broad and fairly regular markings of the same color, alter-
Fig. 98. Painted or Mud Turtle, Chrysemys picta.
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tating with greenish black stripes. The plastron or breast-plate is much smaller than the carapace and of a bright orange color, shading toward the edge into bright scarlet. The head is rather short, with two sulphur yellow spots on each side. The neck has regular yellow stripes on the sides and below. The tail is long and slender and light red below. Legs and feet are blackish, the latter being armed with sharp claws. The two shells are joined by a strong band and are, therefore, rigid. The markings and coloring vary, not only in specimens of equal size, but also with age, so that older specimens do not show at all, or but very faintly, the red triangular spots seen on the marginal plates of the young turtles.

The Painted Turtles are common in ponds and wet ditches in some localities, but they are very shy and therefore not easy to catch. On warm summer days they can be seen in rows on trees overhanging the water and close to its surface. They seem to sleep and
bask in the sun, but as soon as anything unusual approaches or the slightest noise is heard, down they go into the water, barely leaving a ripple to indicate the spot where they have disappeared. Once in the water they are difficult to locate, as they are rapid swimmers, scattering in all directions to hide beneath stones, roots or aquatic plants, from which it is difficult to dislodge them. A good way to catch them in a pond is to use a strong net of moderate size with a long handle, and to follow them through the vegetation, where they are somewhat hampered in their escape. This turtle is perfectly harmless, seldom, if ever, attempting to bite in order to defend itself against undue familiarity. When fully grown it attains a length of about ten inches.

The Speckled Tortoise, Spotted Turtle (Chelopus guttatus) is a very attractive turtle of small size, being seldom larger than four inches. The carapace is moderately convex and of elliptic shape, its color varying from
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Fig. 99. Spotted Turtle, Chelopus guttatus.
a yellowish brown to olive black, the latter color being apparently that of the female. Numberless roundish spots in yellow of different shades are scattered, not only over the back shell, but also over the soft parts of the body. On the under side of the legs a solid yellow takes the place of the spots. Head and neck are rather long and slender with irregular spots and blotches of yellow and orange. The tail is of medium length, striped with yellow. The plastron is large, almost of the size of the carapace, and is of a grayish black color with a more or less pronounced yellow field of irregular outlines in the middle.

The Spotted Turtle is a lively little animal and quite commonly seen in wet ditches and small creeks or low swamps. It can easily be caught with the hand, and is as harmless as the previous species, living very well indeed in the aquarium.

Muhlenberg's Tortoise, Water-turtle (*Chelopus muhlenbergii*) resembles the Spotted
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Turtle in size, form and habits. The carapace is elongated and forms a rigid case with the plastron. The upper shell has yellow markings on a brown ground, but the round yellow spots are missing. The plastron is almost black with a yellow inner field. Neck and head are rather slender; the latter bearing a good sized spot on each side, varying in color from yellow to vermilion.

While this turtle is not rare, it is rather difficult to obtain young specimens. It is found in slow-running streams and creeks.

The Peacock-eyed Turtle (*Clemmys irregata*) is one of the gems of its family. It is almost circular in shape. The edge of the carapace is faintly serrated, while a clearly defined strongly serrated ridge divides it lengthways into halves. This turtle derives its name from a very intricate design in different shades of yellow and a color varying between olive green and grayish brown. In the marginal, and some of the adjoining, plates of the carapace the design resembles
in shape the spots in the tail feathers of the peacock, in others it consists of an arrangement of alternating parallel stripes of different intensity in the above named colors. The

under margin of the carapace and the whole of the rather small plastron, including the connecting part between the two, bear on a bright yellow ground a number of eye spots
arranged symmetrically in such a way, that the two placed opposite each other have the same shape, size and intensity of color. These spots consist of a yellow center sur-

Fig. 101. Peacock-eyed Turtle. Clemmys irritata, lower side.

rounded by a circle varying from dark gray to almost black. On young specimens these markings are either missing altogether or only more or less indistinctly indicated. The head is short and very blunt, in expression
not unlike that of a miniature pug dog. The neck is strong and short. All the soft parts of the body are marked symmetrically with sharply defined yellow stripes. To see this little turtle in its full beauty it should be observed in the water. As soon as it dries the colors lose much of their brightness and the design becomes less distinct.

The Peacock-eyed Turtle is found in our Southern States. It is a perfectly hardy little animal and will live in confinement fully as well, and with as little care, as any other turtle.

*Clemmys species?* While we are aware that the Clemmys irrigata is often subject to slight variations in intensity of color, we must describe a specimen which we found among a large number of normally colored and marked turtles, and which attracted our attention at once, on account of its rich and unusual coloring. The carapace, besides the two markings of the species, was surrounded by a border of flamelike stripes, bright red
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toward the margin and ending, with decreasing intensity of color, about half way between margin and top of shell. The under margin of the carapace was of a bright clear orange red, marked all around with grayish black, almost velvety, round or oval spots, each color sharply defined. The plastron had a few soft gray blotches in a white field along its center line; the rest was orange, light in the middle and growing deeper toward the edge. On the part connecting carapace and plastron a solid dark gray stripe ran close to and along the edge of the first. The markings on the soft parts of the turtle differed only slightly from the true Clemmys irrigata type. As we have not been able to observe other specimens of the same coloring, we cannot decide whether this was only a variety of Clemmys irrigata or a rare species not described before.

The Snapping Turtle, Alligator Turtle (*Chelydra serpentina*) is of value to the aquarist only so long as it is very young and small.
It has no bright colors nor graceful form to recommend it. The carapace is of a grayish brown color and almost round in outline. Running lengthwise over it are three strongly serrated ridges. The front half of the marginal plates has a smooth border, but the rear half is very strongly dentated, the largest dents being nearest the tail. On young specimens the undersides of the marginal plates show irregular blotches of ivory white. The plastron is small, of a grayish black color, and rigidly
joined to the carapace. All soft parts of the body are of a somber gray. The neck is fairly long and thin in comparison with the head, which is very thick, but ends rather sharply. The lower jaw terminates in a strong hook and with its knife-like edge and that of the powerful upper jaw forms a dangerous and effective means of defense and aggression. Even small specimens possess power in their jaws, altogether out of proportion to their size. The feet are large and armed with strong claws. The tail is long and slender but very thick at the root and with a line of horny teeth running on the upper side.

The Snapping Turtle is a voracious and aggressive animal and should, therefore, not be kept in the same aquarium with valuable fishes. It will also dig in the sand, uprooting and destroying the vegetation in the aquarium. Full grown it reaches a length of from twenty-four to twenty-eight inches. It is common in stagnant and slowly flow-
ing waters all through the United States.

The Musk Turtle, Stinkpot (*Aromochelis odoratus*). In comparing our specimens, collected from different sources, with the descriptions given in several books, considered good authorities on the subject, we find discrepancies in some important points. Without going into a very close comparison we describe the Musk Turtle as we see it before us. The carapace is elliptical, with a faintly scalloped outline. A fairly strong ridge runs along the center from head to tail. The plates on the rear two-thirds of the shell slightly overlap each other. The ground color of the carapace is a dusky yellow. The plates have a narrow black border and blackish stripes radiating from the upper edge towards the lower margin of every plate. The marginal plates are narrow, yellowish and divided by fine black lines. The under margin of the carapace is light yellow on the fore part, and black, with yellow dividing stripes, on the rear half.
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Fig. 103. Musk Turtle, *Aromochelis odoratus.*
The plastron is long and narrow with a movable front lobe, and is of a yellow color with symmetrical black blotches and markings. The head, which is very large and borne on a very slender neck, runs to a sharp point, considerably protruding over the mouth. A narrow but sharply defined light yellow stripe runs above and past the eye along part of the neck. A broader and lighter stripe starts below the other one and runs uninterruptedly along the lower edge of the upper jaw toward the neck. No distinct spots appear on the upper side of the head, but the under side of the lower jaw and of the neck are marked with symmetrical light yellow lines and spots. The tail is short. The legs end in strongly webbed feet armed with long, fine claws. All soft parts of the body are of a light, faintly mottled gray.

This turtle owes its English name to an unpleasant odor which is perceptible, if it is brought into close proximity to the nose.
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It is a prettily marked animal and a desirable inmate for an aquarium, not devoted to the keeping of fishes. In the Eastern States it is common in waters with a soft, muddy bottom.

The Mud Turtle (*Kinosternon pennsylvanicum*) is a hardy little turtle less conspicuous because of its colors, than by reason of its remarkable liveliness and agile movements. The carapace is nearly elliptical and, for that of a water turtle, strongly convex. It is of a uniformly dull brown, the plates being indicated by seams only. The plastron is large and divided into three parts of nearly equal size. Its center part, connected with the carapace, is rigid, but the front and hind parts are movable and, if drawn upward, enclose the animal in a solid case. The plastron is blackish brown, shading to a lighter hue toward the edge. The head is long and thick and borne by a long, strong neck. Both head and neck are grayish black, mottled and dotted with somber yellow, their
sides bearing two stripes of the same color. The tail is short and thick. The legs are rather long, terminating in strongly webbed feet armed with long strong claws.

This turtle is, like the previous species, aggressive and a dangerous biter and should, therefore, not be kept with fishes. It is found all over the United States.

The Map Turtle (*Malacoclemmys geographicus*) is a very interesting animal. The carapace is broad and elliptical. The rear third is notched. It is very distinctly keeled and, instead of having the usual convex form, is more roof-shaped, as it slopes almost straight from the keel, or ridge, down to the margin. In color it is olive-greenish brown, showing a network of dark yellow lines, brighter towards the center. The design formed by these lines gives the turtle its name, as it resembles to some extent a geographical map. The plates are slightly wrinkled around the margin and overlap each other slightly at the rear end.
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The under side of the carapace is sulphur yellow with a symmetrical design of grayish black blotches, which show frequent irregular yellow lines. Two large spots of a light sulphur yellow on the part connecting carapace and plastron are noticeable and characteristic. The plastron is light orange yellow. The plates are divided by narrow dark seams. The head is rather small and blunt, with conspicuous eyes placed close to the nose. The iris is golden-yellow, divided into two equal parts by a broad black line. The neck is short and, like the head, has fine and sharply defined lines of clear yellow. A white spot appears in line with, and a little behind the eyes. The lower side of the legs and all soft parts of the body bear stripes of clear yellow on a gray or blackish background. The upper side of the legs is uniformly grayish black. Very large webbed-feet make this turtle a good and rapid swimmer. The tail is long and strong and mottled and striped with yellow.
This turtle is harmless and a more desirable inmate for the aquarium than the former species. It is found in ponds and slow flowing streams in all states from New York to the West.

The Speckled Turtle (*Emys blandingii*) varies a good deal in its markings. While some specimens are covered with numerous bright yellow spots, others show only a limited number of more or less distinct dots, the latter usually being young specimens. The carapace is of a regular elliptical shape, strongly convex and smooth on the margin, almost black in color, with numerous yellow and whitish spots. The plates are clearly defined, each plate showing a design of ridges running parallel with its boundary. Faint yellow rays or flames appear on most of the plates, as well as fine ridges, running from one point toward the border of each plate. The under margin of the carapace is yellow, mottled with black. On each plate of the yellow plastron is a
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large irregular black blotch, so placed that
the inner part of the plastron forms one
broad yellow stripe branching toward the
outside. The lobes of the plastron are mov-
able, but not sufficiently so as to close the
shell. The head is of medium size, rather
flat, with the eyes placed very near the nose.
The neck is long and slender, black above
and golden yellow below. On its upper
side the head bears numerous clear yellow
dots on a black ground, while below, the col-
oration is the same as that of the neck. The
lower side of the legs and the soft parts of
the body are pale yellow, blending gradually
into the darker color on the upper side of
the legs. The feet are only partly webbed
and are armed with long claws. The slen-
der tail is black with yellowish gray stripes
above and below. This is a somewhat rare
species, occurring in the Atlantic and Middle
States.

The Soft-shelled Turtle (*Trionyx spinifer*).
This is by far the oddest of the whole tur-
tle tribe. The carapace, instead of being hard and of a bone-like substance, forms a flat, elastic, leathery shield of a broad oval shape, the widest part being about one-third of its length from the tail. In color it is a light olive green or brown. Large spots of a slightly darker shade than the carapace, surrounded by a deep brown border, are placed on both sides of a clearly defined ridge, or keel, starting at a little distance from the head and running to about the center of the shield. As the spots approach the margin they grow smaller and smaller, until the light center disappears altogether, so that nothing but the brown color remains. A narrow yellowish border runs around the margin, starting as a line in front and broadening gradually towards the tail end. No sign of plates is visible. The surface of the carapace is finely, but sharply, granulated, so that it appears sandy to the touch. The plastron is connected with the carapace by a broad band, leaving
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only a short front lobe and a very small tail lobe free. The front lobe serves to partly close the shell when the animal retires within. The plastron, as well as the lower side of the carapace, and the under side of the legs, are of a light flesh color, mottled with gray along the margin. Darker places show the presence of soft cartilaginous plates underneath the skin, which is so thin and tender that the slightest scratch will draw blood. The head is of a very peculiar shape, ending in a long, pointed and flexible proboscis, with the nostrils placed just as on the head of a pig. The eyes are placed at a considerable distance from the point of the head and show a clear yellow iris. They are also rather large and more intelligent in expression than those of other turtles. Head and neck are of the same color as the carapace and are marked with a yellow line bordered with gray on the sides, and with irregular dark spots and blotches above and below. A yellow line extends from each eye to-
Towards the point of the mouth, forming a fork-like design with the open end toward the eye. The very large and broad webfeet are light olive, strongly mottled with black, and armed with long, very sharp claws. The tail, which is very thick and strong, forming an effective rudder for this skilful and rapid swimmer, is olive colored above with two dark side-stripes, while the under side is yellowish white.

Soft and flabby as this turtle is, it has good strong jaws and it knows so well how to use them that it should not be kept in the same vessel with fishes. If handled, it will extend its long neck to the fullest limit and try to nab an unsuspecting finger. The Soft-shelled Turtle occurs in rivers and lakes of the Eastern, Central and Southern States.

The Southern Soft-shelled Turtle (*Trionyx ferox*) is only admissible in the aquarium so long as it remains small. As it does not differ much in shape from *Trionyx spinifex*, a long description is unnecessary.
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The color, however, differs considerably from that of the previous species. The carapace is of a deep grayish black symmetrically marbled with a slightly lighter color. On older specimens the carapace loses these markings and is of a uniform grayish black color. Near the head a border of sharp granulations is visible. A large number of fine line-like ridges run

Fig. 104. Southern Soft-shelled Turtle, Trionyx ferox.
nearly parallel, lengthwise over the carapace. The lower side of the carapace shows light irregular markings, where it is not connected with the plastron or covered by the soft fleshy parts of the animal. The plastron is of a grayish blue slate color, dark in the center, lighter towards the head, which is of the same shape as that of Trionyx spinifer. The neck is very long and snake-like and so flexible that it is difficult to hold the turtle without being exposed to its bite, which is somewhat powerful. The head and neck bear a number of lines, light yellow near the mouth and orange toward the inner side. The eyes are large and bulging and placed near the flexible trunk-like nose. The legs and feet are slate colored, the latter strongly webbed and armed with small claws. The Southern Soft-shelled Turtle is found in Florida. It is an excellent swimmer. While it may find a place in the aquarium, it is more interesting than attractive and not
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nearly so brightly colored as our Trionyx spinifer.

The Common Alligator (*Alligator mississippiensis*). While the alligator can hardly be recommended for the aquarium it may be mentioned here, because some amateurs may like to keep one or more specimens in a separate tank, or together with turtles, which are well protected against their attacks. To keep them successfully, a dry place of good size must be provided, so that they can easily leave the water to bask in the sun. Only the smallest size of alligator should be kept; and as they are about 8 inches long when they leave the egg, they must be very young indeed, to be adapted for close quarters. They are easily kept on small fishes, raw meat cut in small pieces, or earth-worms. Dull in color and intellect, slow and not over graceful in their movements, they hardly invite the observation which most of the inmates of the aquarium well deserve.
For hours they will remain motionless in one position, barely winking their eyes.

The female lays fifty to sixty large white eggs enclosed in a flexible leathery skin, usually selecting a sandy sunny spot for the nest. The eggs are placed in a depression made for the purpose and are often laid in two layers. The hatching is done by the heat of the sun and the young take to the water as soon as they leave the eggs. The mother usually protects them for a while against enemies. The alligator should not be kept with fishes, as even the smallest specimens are possessed with a set of sharp, pointed teeth of which they make use whenever opportunity offers itself. It is found in rivers and lakes in Florida, Louisiana and Carolina.

AMPHIBIANS.

As their name indicates, the members of this family pass their lives partly in the water, partly on dry land. As they will
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frequently stay for a long time on land, it is only under certain conditions that they are suitable inmates for the aquarium. Although the collector may find a salamander in the net together with a fish, it by no means follows, that it should be placed in the aquarium under the same conditions as the fish. If this is done without giving it the opportunity to leave the water whenever it feels the desire to do so, it simply means death by drowning. Such amphibians as remain in the water constantly are exceptions. Some stay in the water during the mating time; others spend the first part of their lives, that is before they attain their final development, in the water, leaving it, however, as soon as they change from the state of larva into that of perfect animal. While some prefer the neighborhood of the water or moist places, others live on trees or in dry places at quite a distance from any moisture. Here we enumerate and describe only a limited number of such amphib-
ians as live in the water permanently, or nearly so, and which can be kept without more trouble than the providing for them of a float or dry place, where they may rest whenever they feel the desire to leave the wet element. The so-called terra-aquarium is best adapted for the keeping of fishes, reptiles and amphibians in one and the same vessel, or for reptiles and amphibians, without the fishes. Here the amateur may have the satisfaction of seeing them mate and multiply, and of observing the highly interesting metamorphosis from egg to larva and then to the last and perfect form.

SALAMANDERS.

The Water Newt, Eft, Spotted Triton (*Dhyemyctylus viridescens*), is the most common and best known of the amphibians adapted for the aquarium. The color above is olive brown, darker on the male, and of a lighter shade on the female. Both sexes are lemon yellow below, closely dotted with black. The
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sides show bright vermilion dots in a black circle. Young specimens have a nearly uniform reddish color, which changes when they reach maturity. The body is rather slender, the tail long and much higher than it is broad, thus forming an excellent rudder. While superficial observation shows no difference in the shape of the sexes, a closer inspection of the male Triton will bring the following characteristic distinction to notice. The hind legs of the male are much stronger than those of the female. They also show a number of rough horny ridges of a blackish color, running crossways over their inner surface. These are destined to serve the male during the mating process.

This Triton is a lively little animal, quick and graceful in its movements, and seldom remaining long in one position,—now coming to the surface for air, then sinking down motionless with head up, or diving rapidly to the bottom, and running along for some
distance, or climbing up the plants and stones looking for nourishment, or playing with others of its kind. While the Triton may leave the water occasionally if opportunity is given, it can be considered absolutely aquatic, and can therefore be kept with fishes. In this case it should be well provided with food to keep it from temptation. To prevent its escape the aquarium should be covered with a fine screen. It is a hardy little animal and will live very well in confinement. It is commonly found in the Northern and Eastern States in shallow ponds and ditches and can be easily caught with a net. Fully grown this little newt is about four inches long.

The Red Eft, Red Newt (*Diemyctylus miniatus*) resembles in shape *Diemyctylus viridescens*. The color is a more or less dusky vermilion of varying intensity, often with a gray shade on parts of the body. In contrast to *D. viridescens* the Red Newt is not found in the water, but in damp places
under stones and under the loose bark of fallen and decaying trees. These little efts are quite common in some localities, where after a warm rain they will leave their hiding places in such numbers as literally to swarm over the ground, to disappear just as quickly and mysteriously, if the hot sun comes out or if the ground begins to dry. Although perfectly harmless, the Red Newt has a bad reputation in some parts of the country, being considered poisonous and therefore avoided or destroyed. It is very peculiar that this eft, if placed in the aquarium, will thrive very well and become aquatic in every respect, but gradually its color will fade, until it resembles, or practically becomes a D. viridescens in color and habit, so that we may well ask if the D. miniatus is a species or simply the product of circumstances. While the latter seem plausible, the fact that the young after their metamorphosis, voluntarily leave the water to live on land points to its being a species. It has also
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been observed that, while D. miniatus will live and thrive, if compelled to remain in the water, it will try its best to escape from it whenever opportunity is given.

The Large Water Newt (*Dicmyctylus torosus*) is a very interesting salamander introduced from California. It is not nearly as well known as it should be. It is aquatic in its habits and altogether not unlike D. viridescens, although much heavier, stronger and larger, often attaining the length of seven inches. Its color varies considerably according to its habitat. While some are very light brown above, others may be found with very dark brown backs. The lower side is bright yellow.

D. torosus can be kept with such fishes as are rapid in their movements, but it would be rather risky to let them share the aquarium with slower fishes, such as some of the Japanese varieties, which are too clumsy to escape in case the Triton should try to nibble at their long tails. This water lizard
Fig. 106. Large Water Newt, *Dicrotels torosus*.
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seldom tries to leave the aquarium. While it is a fairly rapid swimmer and can be very lively, it will often remain motionless for a long while, hanging on to, or resting on a plant. If removed from the water and placed in the terrarium it will live for years, apparently without suffering in the least under the change. As it is remarkably hardy and modest in its requirements, whether in the aquarium or in the terrarium, we cannot recommend it too highly.

The Red Salamander (*Spelerpes ruber*) is one of the most interesting members of the tribe. It is rather difficult to describe as to its color, since it varies greatly under the influence of climatic and local conditions. The specimens from which this description was made, came from the south. The color above is light brown, bearing many small round blackish spots not very sharply defined and varying in size. Sides and belly are light vermilion, but while the sides still show a few of the dark spots, they
are missing on the belly. The sides of the body and tail are distinctly grooved. The head is almost as broad as the body, the very protruding eyes, placed close to the

![Fig. 107. Red Salamander, *Speleobates ruber.*](image)

nose, forming the end point of a faint blackish crossbar. The legs are rather short and of the color of the body. The tail is strong and thick and slightly shorter than the body. For two-thirds of its length the
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tail of the salamander is almost round, but
the last third is much higher than broad and
with a sharp upper edge. While many of
the southern specimens are colored as de-
cscribed above, others are uniformly vermil-
ton, without the brown and black tints, but
similar in all other points. The northern
specimens are usually of a brighter vermilion
than those from the South, but it is not ad-
visable to determine the habitat of the sala-
mander by its color, as variations in both
directions occur.

The Red Mountain Salamander (*Salamandra*
*rubra montanus*) has a longer tail than *S.*
rubra and never shows the black bar be-
tween the eyes. The Red Mountain Sala-
mander is fairly common and is found under
flat stones near, and in cool, clear rivers.
If it is to be kept successfully in the aqua-
rium, it should have a dry place, so that it
can leave the water occasionally. Quick,
smooth and slippery, it is difficult to catch
and is therefore not often met with in the
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aquarium, where it certainly deserves a place. Fully grown it is about six inches long. It is found in almost every state. Although it is aquatic, it can be kept to advantage in the terrarium.

The Viscid Salamander (*Plethodon glutinosus*) is rather slender, with broad head and large protruding eyes, placed close to the mouth. Along the back runs a distinct but shallow furrow. The legs are small in comparison with the size of the body, as are also the feet. The color is black or a very deep bluish black, the back and sides bearing grayish dots of a silvery luster. The lower parts are lighter and while they often show white dots, the latter are not nearly so distinct as those on the back. The lower part of the tail sometimes shows a bluish tinge. The lower parts of the chin as well as the soles of the feet are whitish. While the ground color on all our specimens has showed little variation, the color of the markings has varied considerably both in
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intensity and in tone. The Viscid Salamander is a desirable inmate of our aquarium

Fig. 108. Viscid Salamander, *Plethodon glutinosus*.

but it must be able to leave the water at its own will, as it lives chiefly on the ground.
The Spotted or Striped Salamander (*Amblystoma opacum*) is deep, almost velvety black on the back and the sides. A number (usually from 12 to 15) of crossbars and irregular blotches, varying between a silver and a bluish gray, mark these parts of the body. In some cases the belly is almost black, while in others it is dark bluish gray. The head is broad and clearly defined by the small neck. The body is stout, the tail is nearly round and of about even length with the body; when full grown this salamander reaches a size of about three inches. While it is not aquatic except during mating time, it may well find a place here. It is found under stones near ponds and slow-flowing streams, or under the loose bark of dead and decaying trees in damp places in the neighborhood of the water.

The Tiger or Marbled Triton (*Amblystoma tigrinum*). This salamander has been known for a number of years to the aquarist here and in Europe. It always lives very
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Fig. 109. Spotted or Striped Salamander, Amblystoma opacum.
near the water, so near in fact that it can dive in as soon as it notices the slightest danger or disturbance. For this reason it is rather difficult to catch. Its color varies with the localities and climates in which it is found. In the Eastern States it is grayish blue with irregular black blotches of different size; while in the Southern States it is of a lighter shade of the same color, but the blotches are yellowish, so that it hardly seems the same animal. Those collected near the Atlantic coast showed dark blotches on a brownish ground.

This Triton is a lively and rather desirable inmate for the aquarium, although it should not be kept with valuable fishes, on the fins of which it may wage a disastrous war. If fully grown it may attain a length of 10 inches. While it will remain most of the time in the water, it must have the opportunity to leave it at will.

The Brown Salamander (*Desmognatus fusca*) lives in or near the water, under
flat stones, roots or in other hiding places, and is fairly common in some of the Eastern States; but as it is very slippery and very agile in its movements, it is difficult to catch. It frequently happens that the inexperienced collector will retain only the brittle tail of the animal for his pains. Its color above is of a warm brown. The sides bear numerous gray or purplish spots. The lower side is mottled. The eyes are protruding and prominent. Fully grown it is about four inches long. As in the case of the above it needs a place where it can leave the water at will.

The Black Salamander (*Desmognatus nigra*) lives in or near springs, preferring cool, clear waters. The greater part of its body is of a deep uniform black, changing sometimes to a dark grayish black below. While it resembles D. fusca in all essential points, it is of heavier form. It is quick and difficult to catch. Length four inches.

The Crested Eft, Large Eft (*Triton crista-
tus) is an introduction from Europe. It is a lively and graceful animal, hardy and very easy to keep. While it is not as gaudy in color as most of our American tritons, it compares favorably with some of them. Dark brown above, toward the sides the color becomes reddish brown, changing to bright orange red on the belly, the latter being darkly spotted. Sides and throat show whitish points. The male can be distinguished by a soft serrated comb, or crest, running along its back. During mating time its coloring gains considerably in intensity. A bluish, or mother-of-pearl-colored line runs along the side of the male's tail. Fully grown the Crested Eft reaches a length of four to five inches.

The Mexican Axolotl (*Amblystoma mexicana*). This salamander is one of the best and hardiest for the aquarium. While its habitat is our neighbor republic Mexico, by far the larger number of the specimens sold here come from Europe, where they
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are easily bred. The coloring is a dark brown, irregularly mottled and striped with a deeper, almost black shade of the same color.

For years the Axolotl in its form as larva has been known and kept as a strictly aquatic inmate of the aquarium. Without the opportunity to leave the water it can be kept indefinitely in the larval state, as the metamorphosis will take place only if the larva is compelled or induced to leave the water. In appearance, the two forms, the larva and the perfect salamander, are quite different. The principal characteristics of the larva are the following: a high
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smooth-edged comb, beginning behind the head and running the full length of the body to the end of the rudder-shaped tail above, and continued on the lower side of the tail to the hind legs; also peculiar to the larva are the respiratory organs, in the shape of a bunch of feathery gills of a reddish or brownish color. These gills, while the animal is resting on the bottom of the tank, are usually in a waving motion, causing not only a renewal of the water in the proximity of these organs, but also attracting small fish or other prey, which can easily be engulfed in the spacious mouth of the Axolotl larva.

The larva leaves the egg when very small and grows very slowly, although it may attain a length of twelve inches. If the larva has an opportunity to leave the water, or if the depth of the latter is gradually decreased so that it is compelled to change its purely aquatic life for a more amphibious condition, its exterior respiratory organs
The Inhabitants of the Aquarium 269 will gradually shrivel up until they become unfit for their original function and finally disappear. It is then that the lungs, which were always present in an undeveloped form, expand, replacing the exterior organs in their respiratory functions. The perfect Axolotl will then be able to live on land, where its color will change from the dark, mottled brown to a lighter shade, spotted and striped with grayish brown. The comb disappears and the rudder-like tail becomes almost round in shape. It is a remarkable fact that the larva of the Axolotl is equipped with fully developed sexual organs, so that it is just as fit for propagation as is the perfect animal.

A white or albino Axolotl with dark pink gills is frequently seen and, on account of its very delicate light pink color, is one of our most attractive and interesting aquarium inmates. They mate freely and are as easily kept as the ordinary form. It is rather peculiar, that albino parents often
produce normal offspring and vice versa.

We had an interesting experience with a large female Axolotl larva, imported by Mr. Eggeling with many smaller specimens during the month of February 1907. Shortly after its arrival the female oviposited freely, the eggs being several hundred in number. They resembled ordinary frog spawn in shape and appearance, but were not massed together in the form of a ball. After a few days the embryos commenced to expand and to show life, and after about ten days the little larvae left their glassy shelter and swam freely about in the water. They showed the feathery gills very plainly but there was no sign of legs. In spite of the greatest care, the development of our larvae is exceedingly slow, but apparently they are thriving as well as can be expected, although it is as yet too early to form any conclusion as to our success in the raising of the Axolotl from spawn, and within the limited confines of the aquarium.
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The Olm (*Proteus anguineus*) is found in the waters of the cave of Adelsberg, Austria. Living in absolute darkness, this animal has no use for eyes and is therefore blind, the eyes being indicated only by two dark dots. Its body is eel-shaped and of a silver white or tender pink color. The legs are very short and weak in proportion to the body. Three feathery pale rose gills on each side of the head form the respiratory organs. The Olm differs from the Axolotl in that it never changes its mode of respiration. While it may leave the water occasionally, it remains aquatic in its life and never breathes through lungs. It has been raised in captivity and will live for years in the aquarium, provided it is kept as much as possible in surroundings resembling those of its natural habitat. A soft comb, or crest, running along the back of the larva is its main distinction from the perfect animal which it otherwise resembles in shape and color. If exposed to the light, the pink
or white color gradually changes to a dark silver gray. Mr. Eggeling’s experiences with the Olm as an aquarium inmate are satisfactory in every respect.

The Mud-puppy, or Water-dog (*Necturus maculatus*), is found in the region of the Great Lakes and in the Eastern States. It is nearly related to the Olm and is dark brown above, mottled with lighter blotches of irregular shape and different size. The belly is yellowish-white or light brown and shows some roundish dark spots. Fully grown it is often from 20 to 24 inches long. The body is very soft but not ungraceful in form. The head is broad and clearly separated from the body by a slender neck. The eyes are very small and not nearly as prominent as in many other salamanders. On each side of the head there are three gills which are of feathery appearance and a rich velvety purple color. The Mud-puppy is somewhat nocturnal in its habits, being very lively and
The Inhabitants of the Aquarium 273 active in the evening and at night. It can be bought from dealers at a low price and will live well, both in the aquarium and in the Terra-aquarium.

The Hellbender (*Cryptobranchus alleghaniensis*) comes from the Ohio valley and from some of the Central States. In color and shape it is decidedly ugly. Blackish or very dark grayish brown all over, it is not easily distinguished from the muddy bottom on which it often rests during the daytime. The body is broad, flat and very flabby, so that it is not altogether pleasant to handle. The exterior respiratory organs are missing, two plain openings taking their place. The tail is high and narrow and forms an excellent rudder, serving with the four strong legs, to propel quite rapidly their apparently clumsy and helpless owner. Aquatic in its habits, it cannot live for any length of time outside the water; it can be kept for years in the aquarium, where, although not beautiful, it will
Fig. III. Hellbender, Cryptobranchus alleganiensis.
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prove to be an interesting inmate; particularly since comparatively so little is known concerning its mating and early development, as to give the observing amateur the opportunity of making important discoveries.

The Brown Hellbender (*Cryptobranchus fuscus*) comes from the Tennessee River; the fact that it is brown in color is its only distinction from *C. alleghaniensis*, with which it is identical in all other points.

The Congo Snake or Eel Salamander (*Amphiuma means*), is appropriately named, as it resembles nothing so much as the common eel. It is a native of the Southeastern States, Florida and South Carolina. Like the eel it will hide its body in the sand or mud until nothing but the pointed head is visible. Thus by day it will lie in wait for its prey. At night, however, it is very lively, its graceful, undulating, snake-like motions making it attractive and interesting, as well as difficult to catch and to hold. The four feet are not
much more than indicated, being altogether out of proportion to the large body; they are of only secondary importance as a means of motion. The body is of a dark slate color, growing lighter on the sides and the belly. While the very young Amphiumas have the exterior gills, even small specimens show plain openings for breathing, so that we have a right to assume that the gills disappear very soon after the larva leaves the

Fig. 112. Congo Snake or Eel Salamander, *Amphiuma*
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Fig. 113. Mud Eel, Sirex lacertina.
The Congo Snake is very hardy and, in water of moderate depth, will keep well in an aquarium.

The Mud Eel (*Siren lacertina*) resembles the Amphiuma in many points. It is one of the rarest of all our salamanders and occurs in Carolina, Mexico and Texas. Usually it is dark slate in color, but on a number of newly arrived specimens, we have observed white spots all over the body, decreasing in intensity towards the belly. The gills are very prominent and of a bright red color. The hind legs are not visible, only the two small front legs being developed.

FROGS.

While the frogs, or most of them, can live for a considerable time at a distance from the water, and, while some species may be found in places temporarily fairly dry, when mating time comes in spring they will without exception seek the water. They then leave their usual haunts, whether they be
trees, meadows or marshes. As soon as the eggs appear the fertilization by the male takes place. The eggs, originally small, are surrounded by a gelatinous coating which considerably increases in size as soon as it reaches the water.

After the mating process, the frog-couples separate and return to terra firma, leaving the masses of eggs where they were produced. After a few days these masses appear as big balls consisting of a large number of glassy round cells with small dark centers,—the embryos. The latter soon grow in size and, according to weather and species, the larva leaves the sheltering egg after between 8 and 14 days, to commence life as the well-known tadpole.

It is most interesting and instructive to observe the growth and development of the embryo from the first day. The originally round little body will soon begin to stretch and change its shape, until a thick, roundish body and a long, strongly depressed tail can
be distinguished. While the frogs interest us chiefly as inmates of the aqua-terrarium, the larva only is desirable for the aquarium, where, feeding on refuse, vegetable as well as animal, it does good service as a scavenger. We recommend the following species for the aquarium:

The Bull Frog (*Rana catesbiana*), one of the biggest and best known of the batrachians, gets its name from its voice, which is radically different from that of all other frogs, being deep and powerful and frequently heard even in the daytime. In the Northern States this frog grows to the respectable length of six inches, while in the South, much larger specimens can be found, some attaining a length of from 8 to 9 inches. In shape the bull frog is stout, with limbs rather short, but strong and well adapted for rapid swimming. The head is broad and the mouth so wide that it enables this voracious robber to swallow prey of nearly its own size. Characteristic is the large
The Inhabitants of the Aquarium 281 ear, or sound plate. The color of the bull-frog varies greatly. While on some, the ground color of the back is a dusky olive brown, mottled with darker blotches of the

![Bull Frog, Rana catesbiana.](image)

same color, others show, generally on the sides, a considerable amount of green. Toward the belly the color grows lighter, changing into a yellowish white with sulphur yellow markings where the legs begin.

The Leopard, or Shad Frog (*Rana vires-
Fig. 115. Leopard Frog, *Rana virescens*. 
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cens), is a very handsome species. It is of medium size, but not nearly so heavily built as the previous species. The upper surface of the body is a light yellowish green. Two rows of large irregular spots of dark olive green or brown, bordered with sulphur yellow, run parallel down the back. One stripe of blotches of the same color, with the same border, runs along each side. The upper green surface of the hind legs is marked with dark olive bands. The belly is silvery yellowish white.

The Pond Frog (Rana clamata) resembles in shape a young bullfrog. In color it is somewhat brighter, showing a lustrous green on parts of the back and along the sides near the head. The ground color above is olive green marked with irregular blotches and spots of a darker shade of the same color. Dark bars or stripes are seen on the upper side of the hind legs. On the lower side of the body the color is silvery white, except on the throat, where it is
bright citron yellow. The markings on this species vary considerably in shape, intensity and shade of color. The habitat may cause these variations.

The metamorphosis of frogs in general, from tadpole to frog is a gradual one and lasts, according to species, from a few months to almost two years. First appear the hind legs, then the fore legs, then the tail begins to shrivel until it disappears entirely, thereby completing the transformation from tadpole to frog. Now the frog will leave the wet element and commence a new and different life.

THE LOWER AQUATIC LIFE.

Snails excepted, the lower animals may as a rule be excluded from the fresh water aquarium, but as some of our readers may be sufficiently enthusiastic to try their hand at aquatic entomology, we enumerate here a few of the better known insects.

The development of the different beetles
The Inhabitants of the Aquarium offers a fascinating subject for the careful and patient observer. Their life, mating and propagation, of which most of us are so ignorant, are indeed well worth studying and it pays to devote a few small glasses to their use. To study the water insects undisturbed, each species should be kept apart. The amateur who takes pleasure in going out with net and pail to collect his own specimens, will find it an easy matter to populate his glasses, as in hunting for fishes, turtles or frogs, he will frequently find a variety of insects in the net, or in the dense bunches of aquatic vegetation growing in shallow waters.

INSECTS.

The Yellow-bordered Water Beetle (*Dytiscus marginalis*), which is one of the best known of all the water beetles, is about one and one quarter inches long and three quarters of an inch broad. Its color is almost black with a dark olive green luster, the
upper horny wing covers having a sharply defined dark yellow border. Folded up under the covers are a pair of strong transparent wings which enable the beetle to fly great distances at a good speed. The body is light, convex and very hard and glossy all over. The small head shows two big black eyes. Of the six legs the hind pair is strongly developed and furnished on the inside with a dense line of very stiff light
brown bristles. These legs and the general shape of the insect make it one of the most rapid swimmers. The male can be distinguished by the disks or cushions on the fore-

![Yellow-bordered Water Beetle, *Dytiscus marginalis*, female.]

legs, which serve to fasten the male to the female during the mating process.

While this beetle stays for a long time under water, either near the bottom or in the vegetation below the surface, it must come up occasionally to take in a fresh sup-
ply of air. This it accomplishes by turning the rear end of the abdominal part of the body upward, lifting it somewhat out of the water, and, at the same time slightly opening the wing covers for a moment. In the evening the beetles leave the water and can frequently be seen around electric lights. After dropping to the ground, if the surface is smooth, they have great difficulty in rising again, and they can then easily be collected in large numbers. The object of their flight abroad is either to hunt for prey or to mate. Often they will be found in puddles of rain water, in barrels or other vessels filled with water and remote from any pond or river. To prevent their escape, the vessel, in which they are kept in confinement, should be covered with a fine wire netting.

The Yellow-bordered Water Beetles are by far the most fearless, aggressive and cruel robbers of the many which make life miserable for the fishes, amphibians and even the larvae populating our waters.
Neither size, means of defense nor rapidity of motion protect the selected victim. The beetle fastens itself to a convenient part of the body and, undisturbed by the frenzied efforts to escape, the wild dashes against stones, or the wriggings on the bottom of pond, river or vessel, he feasts on his living prey, inflicting torture and often wounds, from which even good-sized animals perish. The larva of this beetle is dull gray in color. The head is armed with a pair of powerful mandibles, which serve the larvæ as they do the beetle. Six legs are attached to the breast. The body is long, slightly flattened and divided into nine rings. The pupa resembles the larva, but shows more of the form and parts of the beetle, which leaves it by bursting the back of its shell. To keep this insect successfully, plenty of food should be provided for it.

The Small Yellow-bordered Water Beetle (*Acilius sulcatus*) is about half an inch long and proportionally broad. It resembles
the previous species in every respect and is equally aggressive and bold a robber, but, on account of its small size, is less dangerous to larger aquatic creatures.

The **Large Black Water Beetle** (*Hydrophilus piceus*) is glossy black in color. The back

![Image](image_url)

**Fig. 118. Large Black Water Beetle, Hydrophilus piceus.**

is strongly convex. This is the largest member of the family, but it is clumsy and not nearly so good a swimmer as the Yel-
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low-bordered Water Beetle. It prefers hunting near the bottom and between the plants and the stones, to swimming in the open water. While a slow swimmer, it is an excellent flyer and can be found far away from its usual haunts. It is rather scarce in comparison with other varieties. Like the others, the Black Water Beetle has to come to the surface for its supply of air, but in contrast to them it comes up head first and uses its feelers or antennæ to gather the air and spread it over the lower side of the body, where numerous very small hairs hold it so that it envelops this part like a layer of liquid silver.

This beetle, on account of its slowness and clumsiness, is not very dangerous to the fauna of the aquarium, which can easily escape from its attacks. Its prey consists of smaller and slow-moving aquatic animals and of fish eggs. If it happens to locate in ponds devoted to the breeding of fancy fish, it can do great damage, if not discovered
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in time. In the absence of a sufficient supply of animal food, it consumes parts of plants and has, therefore, been described as a vegetarian. Only necessity, however, will make it the latter, as it undoubtedly prefers animal nourishment. The larva resembles that of the Yellow-bordered Water Beetle, but although heavier in form, its mandibles are much smaller and weaker. When attacked it ejects a dark, ill-smelling liquid, an effective defense against indiscreet aggressors.

While the mating process of this beetle does not differ from that of other insects, the provision made for the eggs by the female beetle is decidedly wonderful. The latter is provided with glands located on the rear end of the body. From these glands a liquid is secreted which the female spins into a pear-shaped balloon with the point turned upward. This balloon, attached securely to the stem of some aquatic plant, forms the receptacle for the eggs, which are deposited
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in regular rows or layers. To steady this receptacle or nest and keep it in an even position, the pointed part is filled with air. After two weeks the larvae leave the eggs, but remain within the sheltering cover until strong enough to take care of themselves when, by a general effort they burst open their balloon-like home and scatter.

The Whirligig (*Gyrinus natator*) inhabits our ponds and streams and is one of twelve to fifteen species. The majority are steel blue and it is very difficult to classify them without careful study and observation. As soon as the ice disappears and the sun begins to warm the water, the Whirligig appears, one of the first of all aquatic insects to enliven the otherwise dead surface, a certain and never failing sign that spring is coming. In swarms they appear, each single beetle circling around by itself with great rapidity and with hardly any pause. It is very interesting to watch the insects in their graceful and endless play, only disturbed
when a fly, a crumb of bread or some other edible body is thrown into the swarm,—when the circling ceases and they all rush frantically upon the prey, each eager to participate in the feast, only to resume their play as soon as the last vestige of the food has been disposed of. The slightest disturbance in the water or any other apparent danger from the outside will cause a general stampede. With lightning rapidity every single beetle will disappear under the surface. After the danger is past, one by one they will gradually reappear on the surface, to gather again for the interrupted sport. They love the sunshine and prefer to spend dark or rainy periods near the bottom. As it is easy to feed the Gyrinus on small insects and plants, they can be kept to advantage in the aquarium, where their graceful and ceaseless play will be interesting and entertaining, but as, like most water beetles, they like to fly off during the night, a close meshed cover should be provided.
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Boat-fly (*Notonecta glauca*) and others. This interesting little group is represented in our waters by six species. We frequently find it with the Gyrinus, and it is of about the same size as the latter. The hind legs are strongly developed, being very long in comparison with the fore and middle pair,

![Boat-fly](image)

**Fig. 119. Boat-fly, *Notonecta glauca*.

and lined with stiff short hair. They serve as a pair of very effective oars, and on account of their shape and position, very much resemble them, thereby giving the insect its name. The eyes are placed so as to enable the insect to see upward and downward equally well. Head and breast have a
greenish luster. The abdomen is dark gray or grayish brown. The Boat-fly swims on its back and being very rapid and agile in its movements, will easily catch smaller insects for its prey. As it will attack and torment, if not destroy, small fishes it should not be kept in the aquarium together with them.

The Giant Water-bug (*Belostoma americana*) is a strange-looking insect, not very attractive either in shape or color. Fairly broad and very flat, of a somber color, varying from a mottled gray to a dirty light brown, it haunts the vegetation of streams and ponds for its prey, which consists of soft larvae and small fishes. The strong sharply pointed and tong-shaped fore legs enable it to take a good firm hold of anything it can catch. The Giant Water-bug is not a rapid swimmer, but its large wings enable it to fly long distances in a short time, so that it is often found far away from its breeding places. Some of the related water-bugs of
other countries are of considerable size, measuring from two, to two and a half inches in length. Notonecta and Nepa should be handled with care, as they will, without warning, inflict very painful stings. The pain of these stings may last for a few hours, but they never have been known to leave any more serious after effect.
The Water Runner (*Hydrometra lacustris*) lives in ponds and streams in the same localities in which the Gyrinus occurs. Like these they play on the surface of the water, but instead of swimming they run and slide on the surface. Their legs are densely covered with fine hair and the air, gathered and held by these hairs, gives them enough buoyancy to prevent their body from sinking into the water. Being perfectly harmless they can be kept in every aquarium.

May Fly or Caddis Fly (*Phryganca grandis decora*), is a member of the nerve-winged insects (*Neuroptera*), with four large membranous wings of equal size. While the insect itself has no value whatever for the aquarium, its larvae form a very interesting and desirable addition to the inmates. It is known as the caddis, or case worm, a soft-bodied, six-legged being, which, to protect itself against its countless enemies, constructs a tube or baglike case, smooth on the inside, but covered on the outside with
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small stones, little shells and parts of aquatic plants. These the larva joins in such a manner that the result of its labor resembles very closely the bottom of the pond or stream in which it lives. As soon as the larva leaves the egg it will surround itself with some small bits of the material closest at hand, later extending the covering in proportion to its own growth. While it has been observed to feed on plants only, some authors claim that it also feeds to a large extend on fish spawn, so that in years when it appears in millions, as frequently happens, the damage it does in fish ponds is said to be very considerable. After having finished its growth, the larva forms into the chrysalis, using the case as a protection, from which, after a short time, the perfect insect emerges. As the case worm is perfectly harmless in any aquarium not devoted to breeding purposes, it can be kept without any risk whatever.

Water Scorpion or Water Walking-stick
Fresh Water Aquarium

(*Ranatra fusca*) is a very interesting insect. Its name describes its appearance fairly ac-

Fig. 121. Water Scorpion, *Ranatra fusca*.

curately. Its color, which is a uniform grayish brown, blends so completely with
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The color of its surroundings that it is rather difficult to discover. Resembling so closely the decaying or dead part of some aquatic plant, the collector may discover it only when it moves. It is found in ditches and ponds everywhere.

The Diving Water Spider (Argyroneta aquatica) is one of the most interesting inhabitants of our ponds, even if it may not find a general introduction in the aquarium. Anyone who has been out to collect material for the aquarium must have observed a gray-brown spider, not unlike one of our common earth spiders, which, when brought up in the net, makes violent efforts to escape, appearing remarkably dry, considering that it has just been fished out of the water. The inexperienced collector or casual observer may take the spider for the victim of an accident and pay no further attention to it. The better informed and older collector will know at once that the prisoner is the Water Spider and that its aim in leaving the net
Fresh Water Aquarium

is to return as quickly and in as direct a line as possible to its proper element, the water. It pays well to install this wonderful little creature in an aquarium with a fairly dense vegetation, where it will live without any detriment to the other inhabitants, or to place it by itself in a small vessel with some aquatic plants. To see the Water Spider at its best, both a male and female should be secured. They can easily be distinguished, as the male has a very small body and long slender legs, whereas the female has a round thick body and stronger, slightly shorter legs. Their legs spread from about three-quarters of an inch to an inch. When the female spider intends to establish a home, she looks about for a favorable position among the stems of plants, where she begins the weaving, or spinning, of a balloon-shaped nest, of approximately the size of a walnut, proceeding in just the same way as does the land spider,—that is, drawing the thread from the spinning glands at the ex-
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treme posterior end of the body and shaping it with the help of the legs.

The nest being finished, the spider goes to the surface and not only inhales air, but gathers a considerable amount of it between the fine hair-covering of her body, so that under water the latter has the appearance of a ball of liquid silver or mercury. Entering the nest from below, the spider releases part of the air, thereby filling and inflating the balloon and gradually forcing the water out. This process is repeated until the nest is completely filled with air so that it forms a large bubble, securely anchored and at a sufficient depth below the surface, to escape disturbances from above. In this dry little home the family life of the spider is spent, here the eggs are laid in a solid well-protected mass and here the young remain until they are sufficiently strong to leave the sheltering nest. Their nourishment consists of small insects. In the aquarium they can be kept on flies. The male’s part in the
spider's life is a very subordinate one. The male approaches the female only during mating time and it would not be surprising if, as is the case in some of the land spiders, the female should devour her much weaker mate, after the latter has done his share to propagate his kind.

We cannot close this chapter without mentioning the much talked of and written about mosquito. While we do not add anything new to the already bulky literature on the mosquito, we shall not fail to mention that its larvae form an excellent fish food. To obtain a good supply of it, place a vessel of water on a window or anywhere outside, and within a few days little boat-shaped gray bodies can be noticed floating on the surface of the water; these are formed of the eggs of the mosquito, and in a few days the water will be alive with the small larvae. They are very active and reach maturity in a surprisingly short time. The transfer of the water, larvae and all,
The Inhabitants of the Aquarium 305 into a fish-stocked aquarium may indicate one way to fight the mosquito pest. Before long the fishes will begin a campaign of extermination, and soon the last of the larvae will have disappeared. While crude oil and other chemicals can and have been used very effectually to destroy the mosquito larvae, it is to be regretted that they also kill fishes, newts and other enemies of the pest. Thorough drainage of a mosquito infected territory is the only lasting and effective remedy. Clear and deep bodies of water well stocked with fish will be comparatively free from the larvae and should not be spoiled by the indiscriminate application of chemicals, with doubtful effects. By stocking ponds which are the breeding places of the mosquito, with gold or other aquarium fish, a good profit can be secured, with hardly any care whatever, as the fish will thrive very well on nothing but the nourishment offered in the larvae.
SNAILS.

Every aquarium might contain a few of these harmless and interesting mollusks. They feed on algae or plants, of which almost every aquarium contains an abundance and they are in no way detrimental to the well-being of all the other animal inmates of the aquarium.

The Trumpet Snail (*Planorbid corneus*) is the best known and most common of all. It lives in ponds or slow-flowing streams with soft muddy bottoms. The head bears
four threadlike feelers, one long and one shorter pair, which on their inner base bear the eyes. The so-called foot with which they move, is short and blunt at the ends; it is like the rest of the body, of a velvety black or brownish red color. The shell is flat, disk-shaped, and consists of five or six spiral windings, small in the center and increasing in diameter toward the outside. Its color is a dark brown. The Trumpet Snail as well as the other members of the family are true hermaphrodites; in other words, the sexual organs of both sexes are represented in one and the same individual. But to effect propagation a mating process between two snails takes place and is indispensable as the location of the sexual organs in the individual excludes the possibility of impregnation without the co-operation of a mate. This snail propagates well in the aquarium.

The Swamp, or Mud Snail (*Limnæa palustris*), can easily be distinguished by the reg-
ular winding of the shell, running to a rather sharp point. Its color is dark brown. It is common in slow-flowing rivers and ponds and in its habits resembles the trumpet snail. The Mud Snail lives on aquatic plants and should therefore be kept only in aquariums where a thinning out of the vegetation is desired.

The Banded Swamp Snail (*Paludina vivipara*) has a short cone-shaped shell. The head is blunt and carries long, slender feelers which bear the eyes on the base. The foot is broad and long. The color of
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the body is light brown with yellow dots. The color of the shell is a transparent olive green, or brown, and its walls are very thin. The rear part of the foot bears a strong horny plate which firmly closes the mouth of the shell whenever the snail withdraws its body to the inside. In Paludina the sexes are separate, there being both male and female individuals. The main point of distinction is the difference in the feelers. On the male the right feeler which contains the sexual organs, instead of being slender and pointed, is short and much stouter than the left and ends in a club-like swelling. The eggs, instead of being laid after impregna-
tion, remain in the body of the female, until the young snails, perfect in form even to the presence of a little shell, are hatched, when they leave the mother to begin their own independent existence. This way of propagation gave the species its scientific name,—*vivipara*. The Banded Swamp Snail can be well recommended for aquariums.
CHAPTER IV.

THE FEEDING OF THE INMATES OF THE AQUARIUM.

NATURAL FISHFOOD.

To keep fishes, amphibians, etc., in good and normal condition, appropriate nourishment is the factor next in importance to a suitable vessel or aquarium. The best nourishment, if obtainable, is that which the different inhabitants of our aquarium find in their natural haunts or habitations. Most fishes prefer live food, such as small crustaceans, cyclops, cypris and the larvae of our common mosquito or others of the small beings which, by the millions, populate certain bodies of fresh water. Some amateurs may have sufficient time and experience to collect this live fishfood. In most large cities it is not in the market
and, therefore, its use is practically excluded. A good and easily procurable substitute consists of the common earth or angle worm. The best way to use these worms after killing as many as are needed by dipping them for a few moments into boiling water, is to chop them fairly fine, washing the pulp in clear water, so as to remove all slimy parts, thereby preventing the discoloring and cloudiness of the water in the aquarium. Earthworms given in this shape are not only readily taken, but also easily and thoroughly digested by most fishes and amphibians. Very small earthworms can be given to larger fishes and amphibians without being cut into pieces. A good substitute for earthworms can be found in raw meat, if it is entirely free from tendons and fat. Most fishes and amphibians take it readily, if it is given to them finely scraped. All food remnants not consumed after a certain time, should be carefully removed with the dipping tube or the mud-lever, as their de-
caving will make the water impure and may affect the health of the more delicate inmates of the aquarium. Very small young fresh-water snails make a good food for some fishes, but they are not easily obtained. The fresh pupae of the larger species of ants, the so-called ant eggs, which can easily be gathered in woods with a fairly dry soil, or in gardens, where the ants construct their colonies, are an excellent food for most of the inhabitants of an aquarium. Where it is impossible to collect the fresh pupae of the ants, the next best thing is to buy the air-dried ant eggs, offered by all dealers in aquariums and articles belonging to their keeping. Ant eggs of good quality are light in color. A very much shriveled appearance indicates that the pupae or eggs are old and therefore unfit for use, as they then contain very little actual nourishment. Many of the ant eggs of commerce are dried by a heating process, which destroys a large percentage of their
The Feeding of the Inmates nourishing substance. These can easily be recognized by their brownish color, the air-dried ant eggs being yellowish white. Gold fish and their many varieties will readily feed on such tender aquatic plants as the Water-lentils (*Lemna minor* and *Lemna trisulca*), which form an excellent food for them and should be used as long as the warm season permits their collecting.

**ARTIFICIAL FISHFOOD.**

Where natural fishfood, such as has been previously mentioned, cannot be obtained under any conditions, we have to resort to the artificial food. Numerous are the preparations offered by dealers. While some have a certain value, the merit of the majority of them lies in the immense profit resulting from the selling of very cheap material at a high price. The disadvantage of these preparations is their solubility in water. They dissolve almost as soon as they touch the water, causing a cloudy and
muddy appearance of the latter. Such parts as may be consumed by the fishes are not properly digested, so that the excrements resulting from their feeding are semi-liquid and remain suspended in the water, rendering it impure and unfit for the fishes to live in. Proper food causes firm, string-like excrements of sufficient density and weight to sink to the bottom of the aquarium, from which they can easily be removed with the dipping tube or the mud-lever. Wafers, cracker crumbs, etc., are frequently used for food, but, while they are not absolutely harmful, they cannot be recommended, as they contain only a very limited percentage of actual nourishment in comparison to their bulk. Naturally, fishes and amphibians, if hungry enough, will eagerly take anything thrown in the water, as long as it slightly resembles food, but they cannot thrive with insufficient nourishment, and it means in the end slow but sure starvation. The following preparations have long been tried and
The Feeding of the Inmates 315

found satisfactory in every respect, not only by amateurs, but by professional fish-dealers and aquarists.

*Imperial Fishfood.* This is a well and generally known food, answering every requirement. Its composition is the result of long and careful experimentation by European experts. In its present form very small doses will keep the fishes well fed and healthy, as it is concentrated and thoroughly digestible. It will rapidly improve the condition and color of neglected and poorly nourished fishes and can be highly recommended to the amateur who wishes to see his pets remain in good and normal health. The Imperial fishfood will keep unspoiled for a long time. It is excellent for the young fishes, and hatchers, dealers and amateurs consider it an ideal preparation. Its use causes firm excrements, easily removed with the dipping tube or the mud-lever.

*Bartmann's Universal Fishfood* was, a few years ago, introduced in the American
market. It has quickly found favor with all who have occasion to use artificial fishfood and who have been willing to try new and unfamiliar preparations. It consists of different ingredients, compounded by Mr. Bartmann, Director of some of the German fish-hatcheries, and one of the most experienced experts. It is in all respects satisfactory, and compares favorably in price with all preparations and compounds of doubtful value, broadly advertised on this side of the Atlantic. All fishes like it and thrive well on it.

Shrimps, the larvæ of the Ephemerides, both dried and crushed, and the Daphnias, or water fleas, dried, form a good and serviceable fishfood, willingly taken by all fishes.

All water turtles can be fed with ant eggs, earthworms or scraped lean meat, but the feeding has to be done in the water, as on dry ground they would refuse even the most tempting morsels.
The Feeding of the Inmates

The smaller salamanders will take earthworms or very small tadpoles, the larger specimens and varieties take larger tadpoles, small fishes and medium-sized earthworms. Turtles and salamanders can easily be trained so that they will take raw lean meat, cut into thin, wormlike strips, if offered on the point of a small stick. With patience and a little care, most, if not all aquarium inmates, will take nourishment from the fingers. Tadpoles will thrive well on any of the previously mentioned fishfoods.
CHAPTER V.

FISH-HATCHING IN THE AQUARIUM.

GOLD FISHES AND THEIR VARIETIES.

Not infrequently Gold Fishes, Fantails, Telescopefish and other varieties will mate and spawn in the aquarium, provided the latter is of sufficient size, well stocked with aquatic plants and placed in a fairly sunny location. As soon as spring comes, such fishes as have passed the winter in perfect health, will look for mates. It is highly interesting to observe how they chase each other in apparently an endless and aimless play. But after a while we can see that every fish selects one certain individual fish for the object of its attentions. It will follow this one fish unceasingly, rub against and push it sideways and upward, frequently wearing it out, until it is thor-
Fish-Hatching in the Aquarium

oughly exhausted. Whenever this happens we may be certain that the aggressor is of the male, the chased or persecuted fish of the female sex.

While a superficial observation may not disclose the difference between the sexes, certain characteristics are known to exist, by which they can be recognized. The male fish, when ready to mate, shows a peculiar depression near the cloaca, just as if a small piece of flesh had been pinched out. On the gills of some species small convex spots of a grayish color make their appearance and remain during the mating period. Both these peculiarities are absent in the female fish. The latter is, instead, considerably stouter in body, so much so that the difference between the sexes is quite evident.

Soon after the male has selected his mate, the actual spawning process takes place. For the depositing of the spawn, plants are usually preferred to anything else. As soon as the female finishes spawning the
male will approach the eggs and eject a milky fluid over them to effect the fertilization. If this is successful the spawn will have a clear, glassy appearance. If not, the eggs will become opaque and whitish. As the fishes like to feed on their own spawn, it is advisable to cut off all branches of water plants, on which the irregular glassy masses of spawn appear, and transfer them to another aquarium, which is exposed to the sun. According to the temperature of the water, the young fishes will appear after from three to six days.

During the first ten to fourteen days after the hatching of the fishes, no food is necessary, as provision for their nourishment has been made by nature in the very prominent and plainly visible abdominal yolk-bag, which has the appearance of a bladder, from which the head and tail of the young fish protrude and which decreases in size as its contents are absorbed through the development of its minute bearer. The first food outside of
the yolk-bag consists of infusorians, the smallest of animal life, invisible to the naked eye and present in large quantities in the water, as long as the aquarium is well stocked with aquatic plants. When the fishes are between three and four weeks old, small quantities of artificial fishfood passed through a very fine sieve should be given. The Imperial or Bartmann's fishfood may be used. It is advisable to feed frequently, and in very small quantities rather than once in a larger amount, as particles of food not consumed at once cause impurity and cloudiness of the water.

If we wish to see our efforts in the home hatching successful, it is indispensable that the water in the aquarium should be kept at an even temperature. It should be kept as nearly as possible at 20° Centigrade (i.e. 68° Fahrenheit), and although it may sink temporarily as low as 15° (59° F.), or rise as high as 30° (77° F.), the middle temperature is the most favorable. Sudden and
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considerable changes one way or the other will always destroy all or most of the very tender and sensitive little fishes.

**Paradise Fish** (*Macropodus viridi-auratus*). To have these fishes spawn a small aquarium will be found sufficient, but if possible no vessel should contain more than one pair and plenty of vegetation should be provided. It is very interesting to observe the courtship, the constructing of the nest and the care and devotion bestowed upon the eggs and the rather helpless newly hatched fishes. During June and July after the water has been thoroughly warmed, the courtship of the Paradise fish begins. The beautiful colors gain considerably in intensity and the points of the fins appear to grow longer. The male fish spreads his fins and swims around the female in graceful curves, caressing her with parts of his body and touching her with his mouth. After a while the female will respond to these advances and then the very interesting love-play is at
its height. Now the male fish selects a site for the nest, the future home and nursery, which is usually a safe corner in the aquarium, where the stems and leaves of the aquatics offer a hiding place. The nest itself consists of an accumulation of air mixed with the rather sticky saliva of the male and forming a fairly substantial mass. Frequently, and if not prevented by leaves, it will appear slightly above the surface of the water. As soon as the nest is completed and usually early in the morning, the spawning will take place. It frequently happens that some of the spawn sinks to the bottom of the aquarium. This is carefully gathered in the mouth of the male and transferred to the nest. The female, thoroughly exhausted by her part in the work of propagation, rests and tries to hide between the plants and stones of the aquarium, but the male, who is henceforth the sole and only guardian of the nest and its precious contents, seems to ignore or forget his previous relations
with his mate and treats her like a common intruder, persecuting her in the most vicious manner. It is therefore advisable to remove her, so as to leave the male in undisputed possession and care of the nest and its surroundings. Under favorable conditions we may, after two days, perceive the very small young fishes. They remain in the nest. Should one or the other have the misfortune to tumble out, the careful father will gather it in its mouth and bring it back into the safe shelter of the nest. This process has been misinterpreted by some observers, who accuse the certainly conscientious parent of feeding on his own offspring. After from eight to ten days the young fishes, often to the number of from one to three hundred, begin to leave the nest. In the beginning and as long as only a few of the most daring little fishes desert the sheltering confines, the male tries to drive or carry them back. Soon, however, a general and not to be prevented exodus takes
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place. The young fishes scatter over the whole aquarium to hunt for nourishment. The parental authority is at an end and with it the parental feeling on the part of the male. It is now time to remove the father, if we do not want to run the risk of seeing the young consumed by the parent, who no longer recognizes them as his own.
CHAPTER VI.

FISH MALADIES.

While according to an old saying "an ounce of prevention is preferable to a pound of cure," even with the greatest and best of care, maladies, parasitic or nonparasitic, may appear in the aquarium. If parasitic, they have been caused by the introduction of fishes and plants from infected waters, if nonparasitic, mistakes in feeding, sudden changes in temperature or similar happenings may be responsible for their appearance.

In cases where it is only a question of replacing common and easily obtainable inmates it is safest and most satisfactory to remove the contents of the aquarium, subject it to a thorough cleaning and restock it with healthy plants and fishes. Where
the health, or even the lives of fishes of special value become endangered by one or the other complaint to which they are subject, it pays to try to cure them by following the directions based upon the experience of practical aquarists and fish hatchers.

The nonparasitic maladies, due to mistakes in treatment or lack of care of the fishes, if not too far advanced, can often be checked and eventually cured by better care and closer observation of the habits and requirements of the inmates of the aquarium. A healthy fish is usually lively, alert and rapid in its movements, during which the fins are well extended. It will remain under water most of the time and readily take the offered food. As soon as a naturally lively fish begins to be sluggish, when its colors fade or lose their luster, when it declines or ignores the offered food, and remains near the surface of the water with fins folded and motionless, it is time to commence treatment.
NONPARASITIC MALADIES.

A frequent cause of the suffering and loss of our fishes is lack of oxygen in the water. As this gas is as necessary to the fishes as it is to all other living beings, its absence or exhaustion will result in the suffocation of the population of the aquarium. The lack of oxygen may be caused by overstocking. If the number of fishes is too large in proportion to the amount of water in the aquarium, the amount of oxygen naturally suspended in the water or exhaled by the aquatic plants will be found insufficient for the need of the fishes, which will come to the surface and try to take from the atmosphere the supply which the water should give them. Prompt help will usually remedy the evil. Part of the fishes should be placed in another vessel, the water should be renewed, some oxygenating aquatics should be placed in the aquarium and no further trouble will be experienced. Quite
often the lack or scarcity of oxygen may be caused by too high a temperature of the water. Continued hot weather may overheat the aquarium, temporarily stimulating the breathing process of the fishes. A prompt emptying of the tank and refilling with fresh water of about the same temperature as that first contained in the tank will in most cases bring quick and complete relief.

When we call especial attention to the temperature of the water used for refilling the aquarium we do so, in order to prevent another frequent malady,—the taking cold of the fishes. Paradoxical as it may appear, these cold-blooded animals are subject to colds. A sudden change in the temperature is often caused by refilling the aquarium with water of a much lower temperature than that drawn off. The symptoms of a cold are labored movements. The fishes swim with great difficulty, remaining on or near the bottom, or resting on
the plants. To cure the fishes the aquarium may be temporarily exposed to the sun, or where this is not practicable, luke warm water may be gradually added until the temperature is again brought up to the normal point, between 26 to 30° Centigrade, which is equal to 79° to 86° Fahrenheit.

Careless feeding, or feeding with unsuitable preparations, frequently cause disturbances in the digestive organs of the fish, in that they cause either too watery excrements or pronounced cases of constipation. Both can easily be diagnosed by careful observation. While in the first case the fish may continue to take food readily, it may refuse to do so in the case of constipation, taking it very sparingly. It will appear unnaturally distended and give off very compact excrements under great difficulties. The replacing of the formerly used food by one of the standard food preparations will frequently help the fishes but it usually takes some time to effect a perfect cure.
A malady of rather frequent occurrence is designated as dropsy. Not all fishes are subject to it, but fantail and other breeds of gold fish, and also Macropodes fall victims to it. One of the first symptoms of the complaint is a peculiar position of the scales. They appear to spread, and instead of forming the usual smooth coating, they stand off from the body and seem to be loose. The color fades and a covering not unlike minute pearls is noticeable, first on the tail and afterwards all over the body. This appearance is evidently caused by the position of the scales. Gradually the whole body expands and, after continued suffering, death relieves the sick fish. What causes this peculiar sickness has not been finally and conclusively determined. Some aquarists hold the scarcity of oxygen in the water responsible, others blame unsuitable nourishment. The attempts to cure dropsy have been successful only when made in the very first stages of the disease. The transfer-
ring of the patients into flat vessels exposed to the sun and stocked with an abundance of oxygenating aquatics has been found beneficial and may be tried, if the lives of valuable specimens are at stake. Careful, not too generous feeding will further the cure. If this malady is not noticed until it is strongly developed it is best to destroy the victims, as at present no effective treatment is known.

PARASITIC MALADIES.

The majority of our aquarium fishes are subject to the attacks of certain parasites, both animal and vegetable, some living on the outside only, others entering the internal organs. The damage caused by these parasites depends upon their abundance. While sporadic individuals may only slightly annoy the fish, their presence is not without danger, as their propagation is exceedingly rapid. They soon form populous colonies and thereby exhaust the vitality of their
Fish Maladies

victim until the latter succumbs to their ravages. Frequently fishes taken from ponds and slow-running streams introduce parasites into the aquarium. Of these, the so-called fish lice can easily be discovered with the naked eye or with an ordinary magnifying glass. They appear as slightly convex dots of a grayish green color and can be removed with the thin sharp blade of a knife. It is advisable to examine fishes taken from local waters or bought from local fish dealers, in order to discover such sporadic parasites, as they will rapidly increase in the narrow confines of the aquarium.

More dangerous than these large and easily noticeable parasites are the minute organisms which infest their host by the thousands, and, not confined to one individual, destroy the whole contents of ponds and aquariums by contagion. As soon as a fish commences to rub its body against the bottom of its tank or against any hard sub-
stance, such as stones or ornaments within its reach, it is time for an investigation. This will usually result in the discovery of small dots or spots of a grayish white color. As time passes these spots will increase in size and number until they form blotches, the latter being covered with a slimy coating. The fins contract and show discolorations of a reddish or grayish color. These are the never deceiving symptoms of parasitic infection. While we do not intend to go too much into details, a few of these parasites may be mentioned here.

The Trematodes contain several species dangerous and often fatal to the gold fish and other fishes related to the carps. The most frequently observed and best known are *Dactylogyrus fallax*, *D. auriculatus* and *Gyrodactylus elegans*. All three live on the surface of the fish, and while *Dactylogyrus fallax* makes its habitat mostly on the gills, the others do not discriminate and infect all parts of the fish. These sucking
pests, true parasites, weaken the fish, its appearance changes, the gills look inflamed and even the scales seem to change their shape and color, while all the fins contract and appear to stick together. After considerable suffering the fish becomes slow and heavy in its motions and finally dies of exhaustion.

Still smaller organisms of the class Protozoa and designated as *Ichtyophthiria* (Fish Destroyer) may attack our aquarium fishes regardless of species or value. They do not live on the surface, but inside the epidermis of the fish. Once there, they increase at a tremendous rate and cause the formation of small white pustules, at first sporadic, but as the disease progresses, increasing in such numbers that they cover the whole fish, fins, eyes and nose included, with irregular white blotches. A heavy coating of sticky slime then envelops the fish and the epidermis commences to drop off in flakes. Often the substance forming the
fins wastes away leaving the rays or spines bare. At this stage of the disease the fish is unable to move at will and death will soon end its suffering.

It is so difficult as to be practically impossible to cure the maladies caused by the previously mentioned parasites, and it is therefore most essential to prevent infection by the introduction of fishes and plants taken from unclean waters. If the amateur aquarist is not absolutely certain that newly obtained inmates for his aquarium are healthy and clean he should place them temporarily in a separate vessel, that is to say in quarantine. If after about two weeks’ observation they show no dangerous symptoms, they may be placed safely with other fishes.

Of the vegetable parasites certain fungi are not infrequently found in our aquariums. From our own observation we conclude that they seldom infest an absolutely healthy, uninjured fish. The point of in-
Infection is usually a slight abrasion on some part of the body. Here the spores of the fungus locate and from this point the growth spreads through, and over the fish, often settling in the gills. Once there, the growth interferes with the respiration of the fish, causing serious inconvenience and, in case of neglect, death. The fungus manifests itself first in the shape of whitish spots. From these spots the exterior growth appears, the latter taking the form of a grayish white cloud which, in strongly developed cases will envelop the whole body. As a cure for this, as well as for most other diseases of a parasite character, a 2–3% solution of common table salt in water has been recommended. The infected fish is to be placed in the salt water and kept there for about an hour. This bath can be repeated a few times. While a partial destruction of these parasites may be effected through this treatment, an absolute and radical cure should not be expected. In all
cases where parasitic maladies appear, by far the safest and most satisfactory, if the most radical, way to remedy the evil is to remove the contents of the aquarium, thoroughly clean the latter with a strong solution of salt and restock it, being careful from where plants and fishes are taken.

All in all, parasitic maladies are of comparatively rare occurrence in our aquariums and with proper care and a little precaution the danger of their appearance may be reduced to a minimum. The remedies and the treatment recommended by some authors and practical pisciculturists may be of limited value in cases where very valuable and rare specimens are the patients. For the amateur we believe the radical treatment here recommended to be the safest, easiest and most satisfactory.
CHAPTER VII.

IMPLEMENTS FOR THE CARE AND KEEPING OF THE AQUARIUM.

NUMBERLESS more or less complicated appliances have been, and are offered for the aërating, heating or cleaning of the aquarium. The aërating especially has given cause for the construction of different little machines, some doing the work by air-pressure, others by miniature steam generators, some effecting the aërating by forcing air through the water, others by squirting fine jets of water into the aquarium. To add beauty to utility, fountains have been connected with some of these different appliances. While all these implements may be very interesting toys and while some may even have a limited value, they certainly are not neces-

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sary to keep the aquarium in good condition. The more the care of the aquarium is simplified, and the smaller the number of implements used, the easier will it be for the amateur to succeed in his efforts as an aquarist. The easier also it will be for lovers of nature to study the aquatic life, so interesting and fascinating and yet so difficult to observe under natural conditions. Therefore we mention only the most necessary and the most inexpensive implements, those that can be used by anybody and everybody without the slightest difficulty or long tedious experimenting. The following simple and easily obtained instruments will be found sufficient for the preparing and keeping of the aquarium under all conditions met with by the amateur.

The Filling-tube. This, as the illustration shows, is a long glass tube with a funnel-shaped widening at the top. The lower end is provided with a number of upward pointing prongs each with a hole on top.
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When the aquarium is to be filled this end is held near the bottom. The water is then poured in the wide upper end from where it will descend through the tube and flow out through the small holes in an upward direction thereby leaving the bottom covering of the tank undisturbed.

The Floating Glass Food Frame. This is a very practical little implement, absolutely clean and of such shape that it cannot do any damage to the inmates of the aquarium. It floats on top of the water and by placing the food within it, the scattering of such food all over the surface of the water and the unsightly adhesion to the glass sides of the aquarium, are prevented.

The Aquarium Brush. To clean the inner
surface of the aquarium, the aquarium brush (see illustration) is very useful. Its shape allows one to reach all the corners no matter what the shape of the tank. If the coating of algae, which frequently forms over the inner surface of the aquarium, is somewhat dense, it is difficult to remove, so the handle of the brush should be strong and rigid in order that sufficient pressure can be applied in the cleaning process. To remove the inmates of the aquarium before or during the cleaning or to transfer one or more into another tank, a small net with a soft bag, such as is kept in aquarium stores, should be used. It is not advisable to try
Implements for Care and Keeping 343 to catch fishes with the hand as their fins are easily torn.

_The Refuse-corner_. This is a little tin box so shaped as to fit into one of the corners of the aquarium. It is open on top and, according to the size and bottom covering, from one to one and one-half inches deep. It serves to gather all sediments consisting of refuse food or decaying parts of plants, so that they can be easily removed. To concentrate the refuse a very handy instrument is offered in the _Squirting Tube with Rubber Ball_. The illustration and the name make the use of the implement sufficiently clear. By a fairly careful handling all impurities can easily be concentrated in the refuse corner from where they are to be removed with the _Mud-lever_. This is a
Fresh Water Aquarium

glass tube the shape of which is shown by the illustration. The upper end, that is the one furthest away from the widened part of the lever, is closed with the finger, the lower end is then placed in the refuse corner slightly above the bottom of the latter. The finger is then removed and the contents of the refuse corner will be sucked up at once. The total length of the mud-lever should surpass the depth of the aquarium by about four or five inches. The bell tube, a straight glass tube with one end widened to a cup or bell shape, can easily be attached to the lever or rubber tubing used for emptying the aquarium and will prevent the sucking up of the sand if placed with the wide end near the aquarium bottom.
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